AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

VOLUME 20. NEW YORK, THURSDAY, AUG. 12, 1897. NUMBER 32.

Drawing Dies.

BY J. L. LUCAS.

Drawing dies may be divided into three kinds, as plain drawing or "push-through" dies, solid bottoms or "knock-out," and combination dies. These last named may be subdivided into single, double or triple action, or the number of operations may be extended as far as the ingenuity of the die-maker will permit. In the private press-room of the Plume & Atwood shops, at Waterbury, Conn., seven distinct operations are performed on the work before it leaves the press, the stock being fed in automatically, and the work carried from one set of dies to the next in the same manner. Such presses are only possible when the work is to be done in very large quantities, and the cost of the press and dies is very great—three of the presses spoken of costing nearly $30,000.

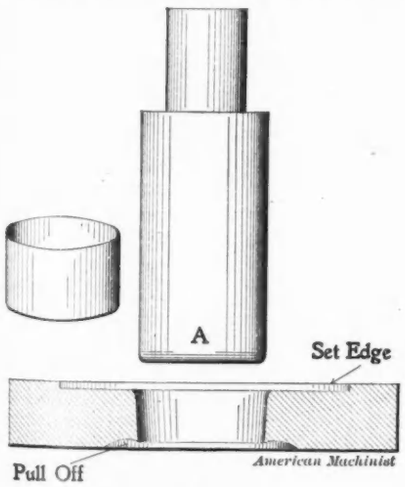

Fig. 1

"PUSH-THROUGH" DIE.

In Fig. 1 we show a plain "push-through" drawing punch and die, the blank being punched out to fit the set edge and then "drawn up," or, rather, it is pushed through the die by the punch. and as the punch rises, the work is stripped from the punch by the "pull-off," which is made very sharp for that purpose. A "draw" of about one-quarter to one-half of a degree is given the die, making it that much larger on the upper side or face, and the upper edge is rounded over and left very smooth, and as hard as fire and water will make it; don't "draw" a drawing die. The lower end of the punch is rounded and left in the same shape; often a die will work much better if the finish is changed from a circular to a lateral polish. The diameter of the punch is equal to that of the die minus double the thickness of the stock you wish to draw. This kind of a die will not work except on shallow work or in redrawing or reducing the diameter of the work that has been previously drawn up, as it will pucker and crimp around the edge. To avoid this, we must have a "blank holder" to hold the stock firmly while it is being drawn.

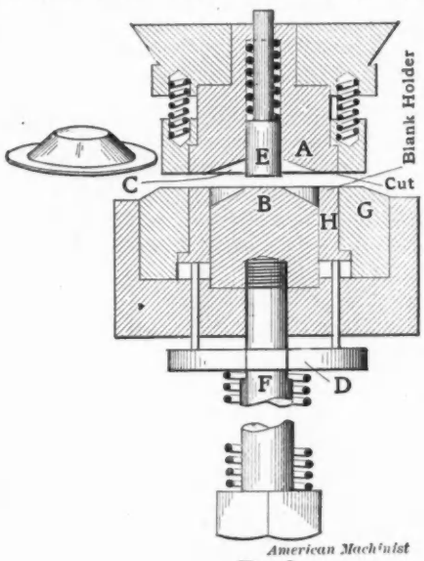

Fig. 2

CUTTING AND DRAWING DIE.

In the next, Fig. 2, is shown a single-action cutting and drawing die, better known as a single-action combination die. A combination die is, as the name indicates, a combination of a drawing die and cutting die in one; it punches the blank and, at the same stroke of the press, draws it up into a cup or shell. (The first use I can learn of these dies in this country was at the Scovill Manufacturing Company, at Waterbury, Conn. Some thirty years ago a die-maker by the name of William Brown made and used a die of this kind. I do not know if Mr. Brown is still in the city of brass, or not; if so, I would like to hear from him. He was a mechanic of great ability, and the die was the result of thought, and not accidental.) The die shown is intended to be used in an ordinary single-stroke power-press, and will draw up work not over 1 or 2 inches deep.

DOUBLE-ACTION COMBINATION DIES.

Fig. 3 shows a double-action combination die, and is a modification of a single action which is to be used in a double-action press. The blank is punched out by the punch *B* and is carried down to the drawing die *D*, and is held there while the drawing punch *A* comes down and draws it into a cup. The lower end of the cutting punch is made very smooth, and acts as a blank holder while the cup is being drawn. This style of a die is used on all work which can pass through the die, such as tops for pepper and salt shakers, mustard-box covers, ferrules and burner parts. This kind of a die has one great advantage over a single-action or "solid-bottom" die, and that is the speed at which it can be run, as the work goes through the die, and is not "thrown off" from top of the die.

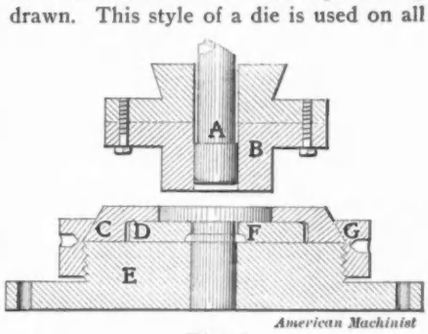

Fig. 3

DOUBLE-ACTION COMBINATION DIE.

SOLID-BOTTOM DIES.

The die shown in Fig. 4 is the same design as the previous one, except that it is a "push-back" or "solid-bottom" die, and is used for taper and flared work that could not be done in a "push-through" die, such as thimbles, taper ferrules and lamp burner parts. The action is the same as the "push-through" style, except that the work is pushed back by a "follow plate" worked by a "knock-out" attached

to the press, and so arranged that, as the drawing punch rises from the work, the "knock out" strikes the plate pin and pushes the work from the die, and is removed either by a swinging arm or by the use of an inclined press.

TRIPLE-ACTION DIES.

Triple-action dies, Fig. 5, are intended to push, draw and stamp the work at the same stroke of the press. The construction is the same as the double action, except that the die block *E* is cut away to allow the stamping die *F* to be set in place, and the shell is carried down to the stamping die and "struck up" between that and the matrix formed on the end of

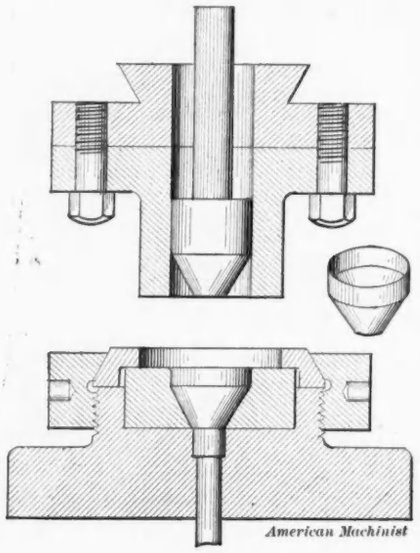

Fig. 4

"PUSH-BACK" DIE.

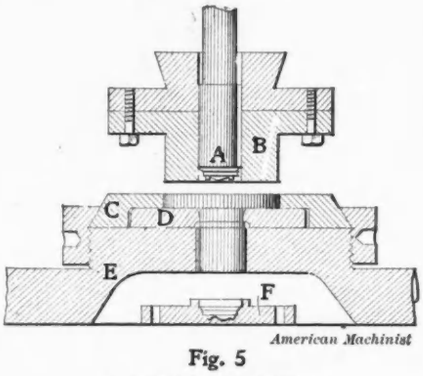

Fig. 5

TRIPLE-ACTION DIE.

the drawing punch, and, as the punch rises, the work is stripped from the punch by the "pull-off," and is removed from the dies by the use of an inclined press, or by a swinging arm attached to and operated by the press, that catches the work as it falls from the punch.

This style of die is largely used on blacking-box covers, lard-pail lids, or other work where a stamped or embossed cover is wanted. A die of this class should always be used in an arched press, as the strain of the stamping process is very severe on the "open-back" style press, and is very apt to crack the body castings. In making a drawing die, use a steel that is high in carbon, and if it shrinks a little in hardening, so much the better. There is on the market at least one grade of steel which will stand three successive hardenings, and will shrink on each of them, so that, as the die wears out, it can be "shrunk up" and then ground out to size again.

The great secret of drawing up work is to have good metal, and then in the proper adjustment of the blank holder, so as to hold the metal just hard enough so that it cannot pucker, and still so lightly that it will draw out from under the blank holder. In drawing up metal, always keep one thing in mind—that is, that metal has some of the properties of water, and it will flow where it can go the easiest. A grade of steel which will harden good, a little knowledge of tool-making and a good deal of experience, are what you need to make a good drawing die.

There is one thing about drawing up a long shell out of a round blank, which is a puzzle—that is, if you draw up a long tube 1 inch in diameter out of, say, a 12-inch round blank, where does the edge of the blank go to? It is 36 inches around that piece of metal when you start work on it, and only 3 inches when you get through. Where has that 33 inches of edge gone to? It is, as one of the boys said to me one day, "all crumpled up and drawn out into the shell."

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The Chattanooga Pipe Foundry.

Through the courtesy of Mr. David Giles, president of the Chattanooga Foundry and Pipe Works, we are enabled to illustrate a new pipe plant which they have recently erected in Chattanooga, Tenn.

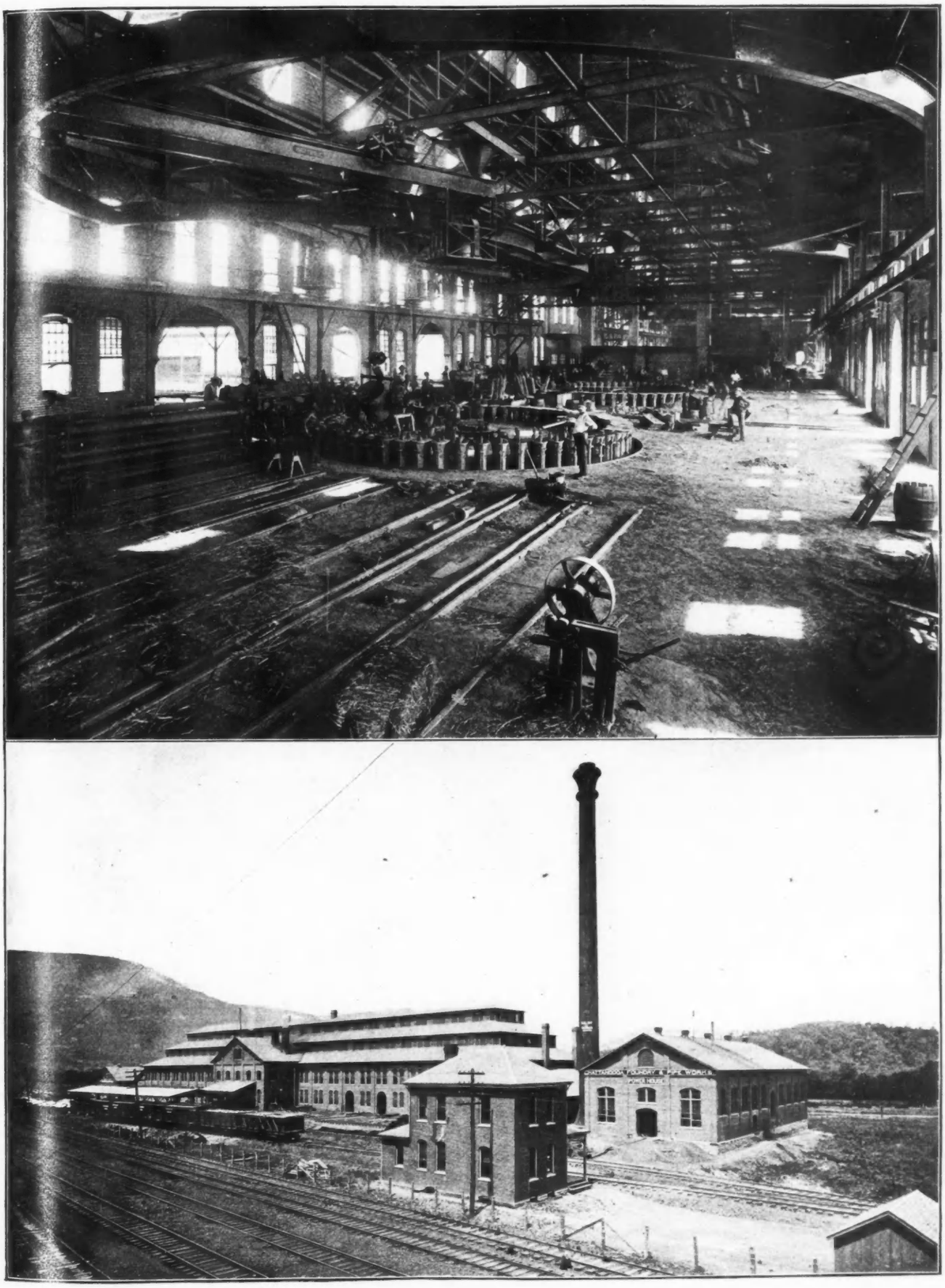
As many know, this company operate a foundry at Bridgeport, Ala., where only the larger sizes of water pipe are made; the original plant in Chattanooga being now used exclusively on fittings and specials. The new plant, therefore, is the outgrowth of a successful career and years of experience, and we think may be regarded as strictly up to date in all its appointments. In briefly describing these works, it is not our intention to dwell on minor details, but simply to call attention to a few of the more prominent features embodied in their construction and operation.

When large quantities of material must be handled daily, and moved from place to place, it is, of course, of the greatest importance that facilities for doing this be of the very best. It may help to a fuller appreciation of the importance of this subject, when we consider that these works have a capacity to consume from 150 to 200 tons of iron per day, an amount equal to the output of two large blast furnaces, and that this material must be handled many times over. Besides this, the various appliances for doing the work, such as ladles, flasks, patterns, cores and sand, make up a total weight, compared with which the finished pipe often bears a small proportion. We shall therefore dwell more at length on the labor-saving devices employed here in handling these materials.

In the general view of the buildings, a commodious stock yard is seen adjacent to the cupolas, with ample railroad facilities, and in addition to these, tramways carry the iron and coke to the hydraulic hoists which elevate them to the charging floor. Extending in either direction from the cupolas is an overhead track, on which an electrically driven car carries the molten iron the whole length of the building. This track is clearly seen in the interior view, at the right-hand side. In this view is also shown a system of electrical traveling cranes, which is quite original, and admirably adapted to the work for which these were designed. One end of the traveling beam is hung by a pivot, directly under which the operator is stationed; here he controls three motors, one for hoisting, one that moves the carriage and another at the traveling end of the beam, for imparting to it its motion. While this interior view is an excellent one, yet the peculiar form and arrangements of these cranes are not so easily comprehended by it; hence a plan, Fig. 2, is shown, which takes in that part of the building occupied by two casting pits, and four of these cranes. From this the relative position of pits and cranes will be seen. This view also shows the track *C*, which brings the iron from cupolas; also those that connect with the core ovens and those on which the finished pipe is cleaned and taken to asphalt ovens and testing machine.

We come now to what may be regarded as the most distinctive feature of these works, viz., the casting pits, of which there are four. The interior view shows but two; the other two are cut off from view by the intervening core ovens seen in the center of the building. These pits were designed and patented by Mr. David Giles, several years ago, so that however unique they may seem, it will be seen that their adoption here is in no way experimental. Fig. 3, which is an elevation of a pit, with the building shown in cross section at the line *o o*, Fig. 2, shows the revolving turret *T*. Upon this the flasks are hung, as closely as is practicable, all round. The utility of this device will be obvious to those at all familiar with pipe-making. A brief description of its operation will, however, be of interest.

The sand and the men who run it into the molds, remain in one position. As their work is finished, the patterns are withdrawn and the turret is turned far enough to bring an empty flask in position. As the molds thus consecutively pass this point they are brought over drying ovens, located at the bottom of the pit, as seen at *A A*, Figs. 2 and 3. This drying goes on while the turret is mak-



THE CHATTANOOGA PIPE FOUNDRY.

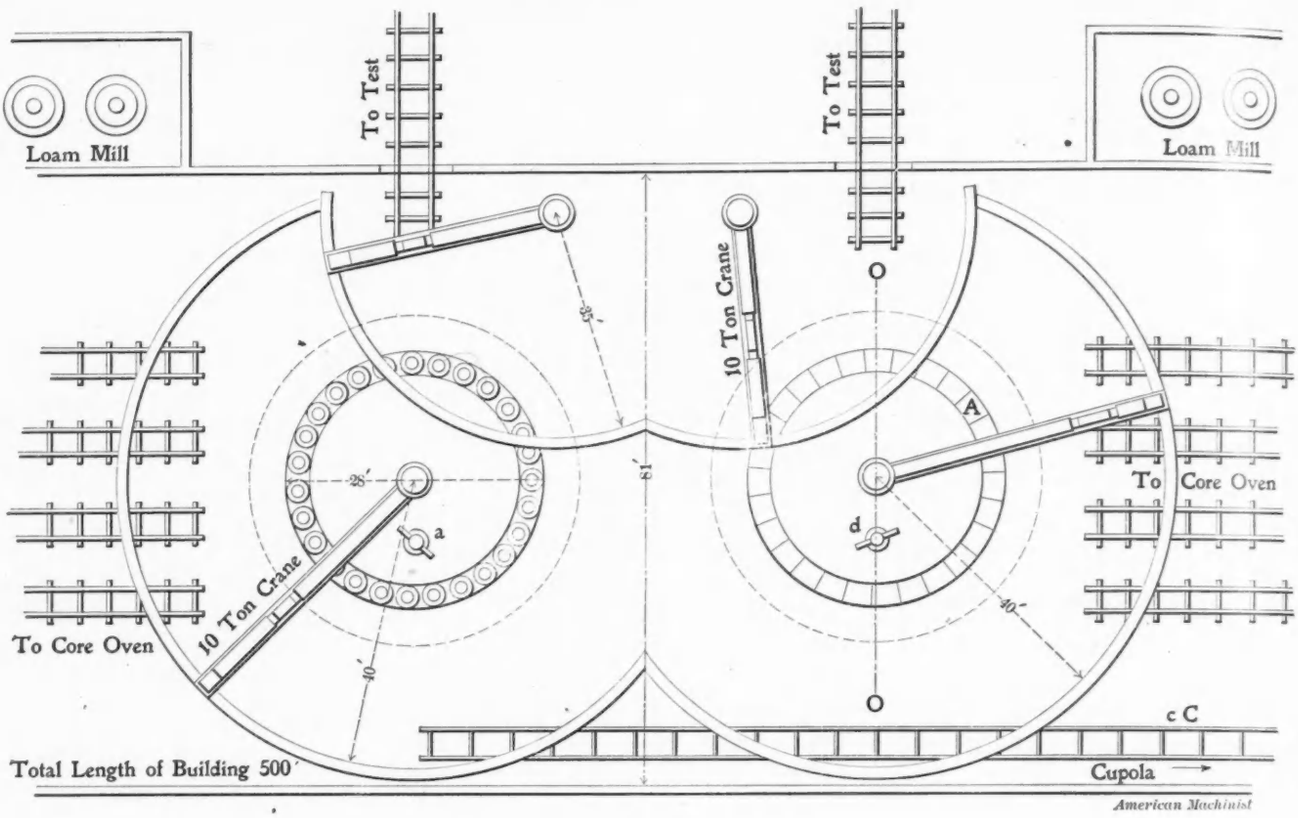


Fig. 2

PLAN SHOWING ARRANGEMENT OF CRANES, TRACKS AND CASTING PITS.

ing about one-third of a revolution. Fig. 1 shows covers on the flasks being thus dried. The cores having been previously dried are now placed in the molds, and they are then ready to receive the iron. A large ladle, which has been thus employed, may be seen suspended by the crane. At the delivery side of the pit, may be seen a flask which has just been withdrawn and emptied of its casting and sand. It is now ready to be replaced on the turret to make another round. In this way it will be seen that these various operations may go on continuously, night and day, if desirable, without any one part of the work conflicting in any way with another.

It might be supposed that these turrets, with their enormous burden, would be hard to move, but their construction is such that one man does this with ease. The description of the "revolving pit," as it is called, will, doubtless, enable the reader to more fully appreciate the importance of the extraordinary facilities for handling things, as seen in the arrangement and various functions of the overhead electrical cranes.

In conclusion, we think the proportions of this structure are deserving of attention, affording as they do, the light and air so essential to the health and comfort of its operatives.

Of the power house little may be said, further than that it is a model of neatness and simplicity. The two Lane & Bodley Corliss engines drive generators which supply power to thirty electric motors, ranging in size from 40 horse-power downward. As an economizer of this energy, ball bearings have been used wherever practicable.

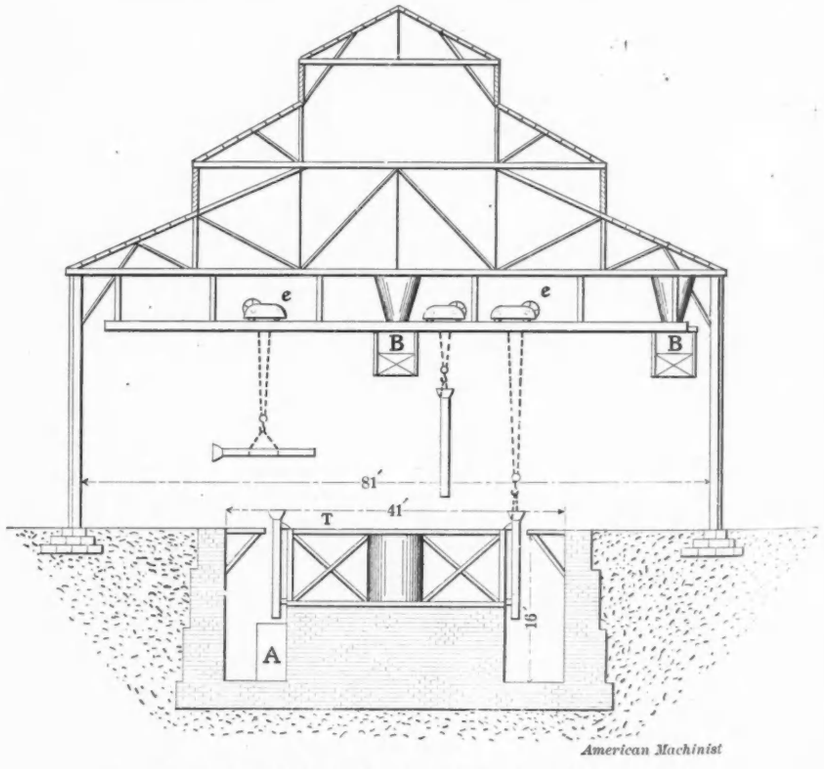


Fig. 3. CROSS SECTION OF BUILDING AND CASTING PIT.

An ample storage yard, for finished pipe, is located at the back of the works, with every convenience for shipping.

While it is quite foreign to the matter in hand, yet it will be of interest to all

to know that in the background seen from these works, is Lookout Mountain, the historic ground where Hooker fought his battle above the clouds.

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Efficiency of Oblique Riveted Joints.

We abstract the following from a valuable article in "The Locomotive" for July.

It will be well first to understand what is meant by the "efficiency" of a joint. Fig. 1 represents a boiler with a double-riveted longitudinal joint, *A B*. If this boiler should burst, it would fail along the line *A B* (provided the plates are all sound and good), since this is the weakest part of the whole structure. But we can easily calculate the force that would be required to fracture the plate lengthwise, as shown at *C D*, provided we know the thickness of the plate and the tensile strength of the material. If we should find, when this calculation has been made, that the resistance along *A B* is only, say, 70 per cent. of that along an equal length of the line *C D*, we should express this fact by saying that the joint *A B* has an *efficiency* of 70 per cent.

The efficiency of the girth joint, Fig. 2, may be found in the same way, by comparing the force that would be required to cause a rupture at *A B* with what would be required to break the solid plate along the parallel line *E F*. With the same kind of joint the relative strength or efficiency would of course be the same for the girth joint as for the longitudinal joint, or, as we have assumed, 70 per cent. of the full strength of the sheet.

There is one very important fact which we have not taken into account, thus far, in making these comparisons. It is that, when a boiler is under pressure, the strain on the boiler is different in different directions, being greatest along a circumferential direction, and least along the direction of the boiler's length. In fact, the strain on a boiler, girthwise, is precisely twice as great as the strain in a lengthwise direction. In other words, if we should mark off a section of convenient length (say one foot) on the line *CD* in Fig. 2, and an equal length along the line *EF*, the strain on the marked part of *EF* would be only half as great as the strain on the marked part of *CD*. It is easily seen, from this, that although the joint *AB* has an efficiency of only 70 per cent. when compared with the solid plate along *EF*, it has an efficiency of 140 per cent. when compared with the solid plate along *CD*.

Still confining our attention to the identical joint that was shown in Figs. 1 and 2, let us now suppose that instead of running either lengthwise or girthwise, it runs obliquely, as shown at *AB*, *MN*, or *XY* in Fig. 3. The effective strength of such a joint will evidently lie somewhere between the two values that we have already found. That is, it will be somewhere between .70 and 1.40, when compared with a constant unit of solid plate of equal length, measured along the line *CD*. The strength of the joint *AB* (in Fig. 3) will not greatly exceed .70, because it is nearly parallel to the length of the boiler; and the joint *XY* will not fall far short of 1.40, because it is nearly parallel to the girth joints; but we cannot yet say much about *MN*, because it is not anywhere nearly parallel to anything. Its strength might perhaps be half-way between .70 and 1.40; but, so far as we can yet say, it might differ quite materially from the exact average of these two figures.

To find a formula that will always give the value of the oblique joint, we must have recourse to trigonometry; but for practical uses we may sum up its result in the following convenient

Rule: To find the effective efficiency of oblique joint, first find the efficiency in the usual way, as though the joint were of the ordinary longitudinal type. Then measure the angle *a*, in Fig. 4, that the oblique joint makes with the girth joint, and find the factor opposite this angle in the table. Finally, multiply the efficiency as found above by the tabular factor, and the result is the effective efficiency of the proposed oblique joint. The effective efficiency so found is to be employed in casting up the bursting pressure of the boiler in the usual way.

Example: A 60-inch boiler has oblique joints which make an angle of 50 degrees with the girth joints. The material of the shell is ⅜ inch thick, with a tensile strength of 55,000 pounds per square inch.

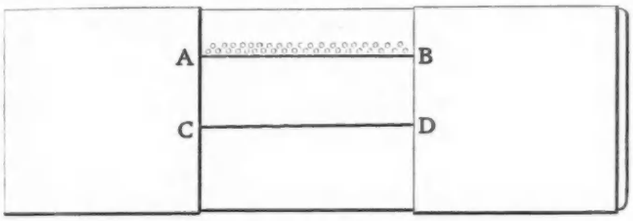

Fig. 1. DOUBLE-RIVETED LONGITUDINAL JOINT.

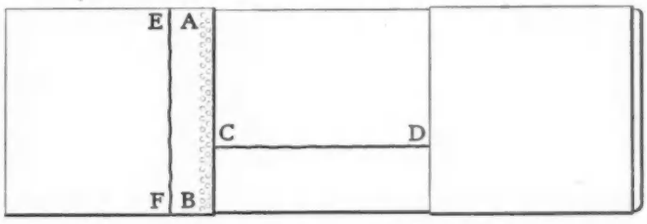

Fig. 2. DOUBLE-RIVETED GIRTH JOINT.

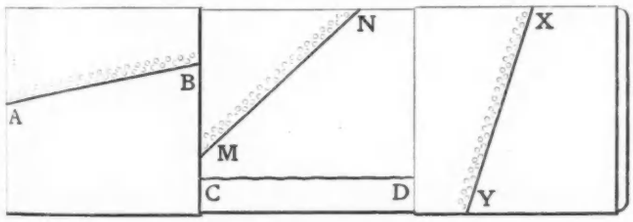

Fig. 3. DIAGONAL JOINTS.

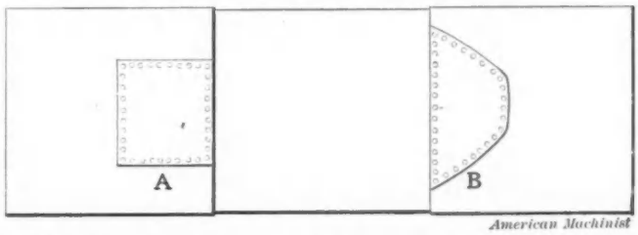

Fig. 5. ILLUSTRATING THE RELATIVE STRENGTHS OF PATCHES.

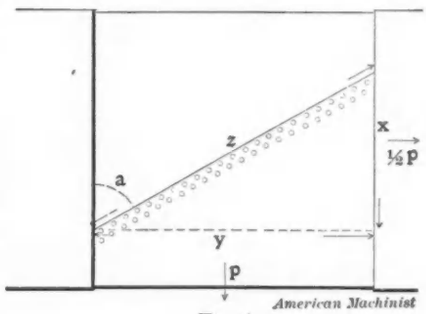

Fig. 4

FACTORS FOR COMPUTING OBLIQUE JOINTS.

a.	Factor	a.	Factor.
30°	1.51	50°	1.20
35	1.42	55	1.15
40	1.34	60	1.11
45	1.27	65	1.08

The joint is double-riveted, the rivet-holes being 15-16 inch in diameter, and the pitch 3 1-16 inches. It is required to find the safe working pressure, using a factor of safety of 5.

Solution: To find the bursting pressure of a jointless shell of these proportions, we must multiply the tensile strength of the material by the thickness of the shell, and divide the product by the radius of

the boiler. The radius is here 30 inches. We have therefore, 55,000 × ⅜ = 20,625, and 20,625 ÷ 30 = 687 pounds per square inch, which is the bursting pressure of a jointless shell of the proposed dimensions. To find the actual bursting pressure of the boiler, we must multiply 687 by the "effective efficiency" of the diagonal joints, which is to be found by the foregoing rule. The effective efficiency of an ordinary longitudinal joint of the dimensions here given has been found to be .693. Now opposite 50 degrees in the table we find the factor 1.20; so that the "effective efficiency" of the oblique joint is .693 × 1.20 = .832. Multiplying the bursting pressure, as already found for the solid shell, by this "effective efficiency," we find 687 × .832 = 572 pounds per square inch, which is the bursting pressure of the actual boiler, as constructed with the oblique joints. To find the safe-working pressure, we divide 572 by the factor of safety. Thus 572 ÷ 5 = 114 pounds per square inch, which is the safe-working pressure desired.

The principle of the oblique joint has an interesting application in repair work. It sometimes happens, for example, that in putting on a patch it is just as easy to give the patch a shape somewhat like that indicated at *B* in Fig. 5, as it is to make it rectangular, as shown at *A*. In such cases the boiler-maker is likely to choose the square-cornered form, because it makes a neater-looking job. The form shown at *B* is much to be preferred, however, for, on account of the inclination of its edges to the girth joint, it gains in strength for the same reason that an oblique joint is more effective than a similarly designed longitudinal joint. Suppose, for example, that the riveting used at *A* and *B* in Fig. 5 is so proportioned that the joint has an efficiency of 56 per cent. when computed in the usual way. Then the patch shown at *A* cannot have a strength greater than 56 per cent. of that of the solid plate, because two of its edges are parallel to the length of the boiler. At *B*, however, the edge of the patch is nowhere anywhere nearly parallel to the length of the boiler. Assuming that its average inclination to the girth joint is not more than 45 degrees, we find, in a general way, how much more effective *B* may be expected to be than *A*. For in the table we see that the factor for 45 degrees is 1.27; and hence the riveting on the patch *B* would have an effective efficiency of 1.27 × .56 = .71, or 71 per cent.; so that *B*, although only single-riveted, would be as strong as *A* could be, even if *A* were put in with first-class double-riveted joints. This point should not be forgotten, when the nature of the defect to be remedied leaves the boiler-maker free to select whatever shape of patch he prefers.

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American aluminum is largely used abroad.

The Arms of Fly-Wheels Cast in One Piece—A Method of Constructing Addition Diagrams.

BY HENRY HESS.

In the "American Machinist" of April 23 and 30, 1896, there was given by Mr. F. A. Halsey a formula for determining the section of elliptical arms for such fly-wheels as were cast whole. This formula was not arrived at by "figgers," but was ground out in the mill of experience. In fact, any other way of getting correct proportions is practically out of the question since the principal thing that has to be looked out for is the effect of shrinkage; and up to date, not even the "theoretical cuss" has been able to formulate laws for the strains set up by metal in cooling under foundry conditions.

Mr. Halsey selected from a large number of fly-wheels, ranging from 33 inches to 8 feet in diameter, those having such arms as looked best to his judgment, and that stood the test of successful making. He found that their arms corresponded to the proportion:

$x = .875 + 0.04\,D + 0.153\,\sqrt{A\,B}$, in which

x = the width of the arm at the rim,

D = the diameter of the wheel in inches,

$A\,B$ = the area of the rim cross-section.

The area is elliptical in section and has a thickness equal to one-half the width, or $\frac{x}{2}$ at the rim.

While not formidable, this equation has quite a number of factors, so that a handy diagrammatic solution may prove acceptable. Instructions for the use of the diagram are to be found on the latter, together with an example and a dotted trace-line showing the course from the known rim area and diameter to the required arm width. For the sake of greater convenience, a double scale of rim diameters *D* is given, the upper in feet and the lower in inches; so that it is possible to use directly whichever unit one choses, without the trouble of conversion.

To those interested in diagram construction, an explanation of the method used for graphic addition in diagrams, and believed to be original, may prove useful. Say that the values on the scale of *D*, Fig. 2, are to be added to those of scale *A*. Draw slant lines from values in *A* at an inclination corresponding to the ratio of the actual lengths of similar values in *A* and *D*. In Fig. 2 the values of *D* are twice as long as similar values of *A;* the inclination of the slant lines will therefore be 1 in 2. To add, trace vertically from *D* to that slant line originating at the *A* in question, and refer the intersection horizontally to the *A* scale, where read the answer. Thus, *D* = 6 referred to slant line starting from *A* = 4 referred horizontally to *A* scale, gives 10 as the sum of 4 + 6.

In the fly-wheel formula the first member to be solved is $\sqrt{A\,B}$; this is done by arranging *A* as a scale of equal parts at the left of the diagram, and by drawing a series of slant lines from *O* corresponding to various values of *B;* these lines also represent a scale of equal parts, as the intervals measured in any horizontal line will show. The intersection of a trace from *A* to *B* referred to the bottom scale will give *A B* in the usual manner; the bottom scale for *A B* is one of equal parts or one of square roots, as may be determined by its inscription with values of *A B* or of square roots of *A B*. In this case, however, no values whatever are written down, as they need not be read off as numerical quantities. The square root values represented by this scale are now to be added to the other terms of the equation; this could be done by an adding diagram, as illustrated by Fig. 2 at the bottom, but this would take up too much space. Instead, slant trace lines are started from the bottom scale from points corresponding to $\sqrt{A\,B}$ to the left-hand or *A* scale. By giving these lines the correct slant they would give at the *A* scale a reading of $0.153\,\sqrt{A\,B}$, which is the last term of the equation. But his would bunch them all in the first inch and a half of the *A* scale, where they would hardly be legible with any practical dimensions of the diagram. In order to spread them out, the factor 0.153 is increased to 0.5. This makes a change in the other factors necessary, as the equation as a whole must not be changed in value. The equivalent equation will then read:

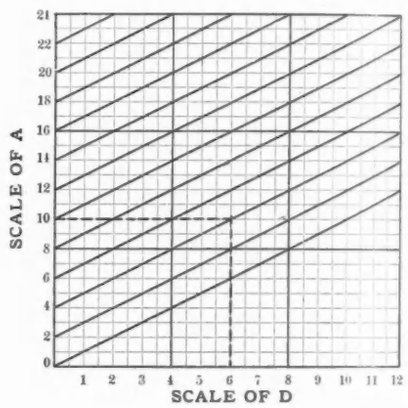
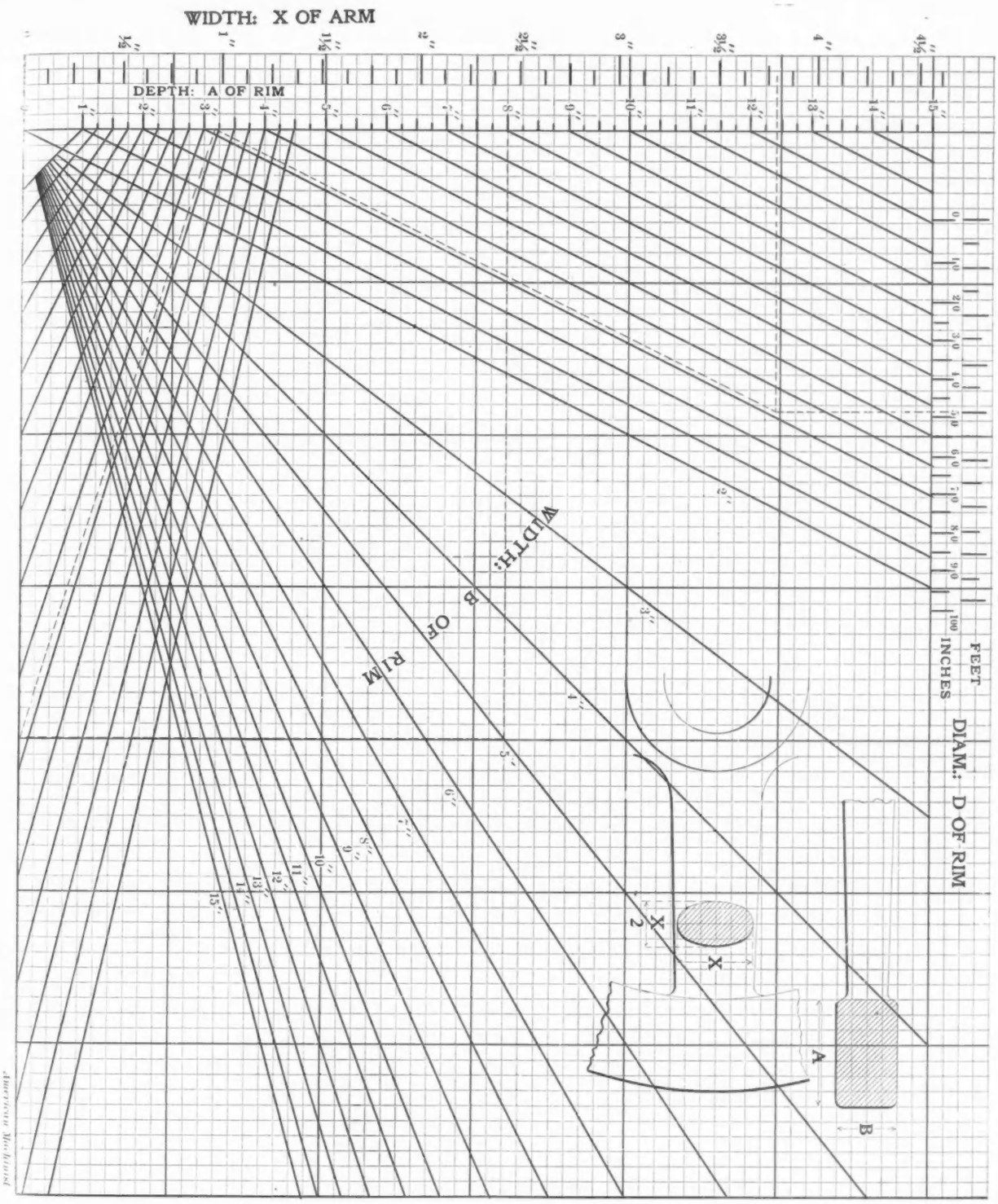


Fig. 2 *American Machinist*

$$x = .306\left(2.86 + 0.131\,D + .5\,\sqrt{A\,B}\right)$$

That portion of the diagram lying between the *A* scale at the left and the slant line *B* = 2 is available for the balance of the solution. First, the values of $.5\,\sqrt{A\,B}$, as given in the *A* scale by the slant lines from the bottom scale are to be added to 2.86 + .131 *D*. The upper edge of the triangular space is used for the scale *D*. The largest *D* to be dealt with in this case, 96 inches, is multiplied by the constant .131 (from the modified equation).



ARMS OF FLY-WHEELS CAST IN ONE PIECE.

Gives dimensions safe against shrinkage strains. Number of arms not considered, as greatest stress, that due to shrinkage, is independent of this. Rim values $A\ B$ may have any relation; $B = \frac{2}{3}\ A$ preferred Other sections to be reduced to rectangle of equal area.

Formula developed from experience with D 33″ to 96″. $X = .875'' + .04\ D + .153\ \sqrt{A\ B}$. See "American Machinist," April 23 and 30, 1896. Example: $D = 48''$ or 4 ft.; $A = 8''$; $B = 5''$. From scale at left for $A = 8$ trace horizontally to slant line width $B = 5''$; intersection down to bottom; between slant lines back to scale A; parallel to slant line up to intersection with vertical trace from top scale $D = 4$ ft. or 48″. Refer intersection horizontally to left to outer or X scale and read $X = 3\frac{5}{8}''$. The arm thickness should be $\frac{X}{2} = 1\frac{13}{16}''$.

and to the result 2.86 (also from the modified equation) is added, giving 15.436 as the actual value of the D scale. At a distance from the left end, equal to $\frac{2.86}{15.436}$ the zero point for the diameter is plotted. The remaining space is then divided up into portions corresponding to wheel diameters, increasing by increments of 5 inches, of which every tenth inch is marked. Just above the inch scale its equivalent in feet is given for additional convenience when the wheel diameter is expressed in feet, as is usually the case. From the A scale addition slant lines are drawn to the D scale at such an angle that each line, from a certain value at A, runs to the same actual value in the D scale. It must be borne in mind that the actual value of this scale is not that marked, but that found before, i. e., 15.436 for its total length. The inclination of the slant lines is 1 in 2, since similar actual values in the A scale are twice as large as in the D scale. In Fig. 2, used in explanation of the principle of these adding scales, the D scale was placed below, but it is perfectly obvious that it could just as well have been above. In the latter case the vertical reference would simply have to be made downward instead of upward. In the main diagram the latter location of the D scale has been chosen in order to avoid crossing the network of lines at the bottom. To add $0.5\sqrt{A\,B}$, as already found at the lower portion of the A scale, it is only necessary to refer it parallel to the nearest slant line to a vertical dropped from the D in question, and refer the intersections to the A scale. But it still remains to multiply this result by .306 to get x. To this end the x scale is drawn just behind the A scale; the level of each value in the A scale corresponds to .306 A in the x scale. So to find x it is only necessary to continue the last horizontal trace to the x scale and read the value indicated.

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Short Gear Teeth.

BY C. W. HUNT.

[The following remarks were made by Mr. Hunt in the discussion of Professor Jones' paper on the strength of gear teeth, read at the last meeting of the American Society of Mechanical Engineers. We publish them from proof sheets of the forthcoming volume of the transactions of the society, through the courtesy of the secretary.—Ed.]

It may be of interest, in connection with this paper, to give the present practice of the company with which I am associated in their use of cast-iron spur gears of comparatively small size, running from about 7 inches to 7 feet in diameter and with teeth having a circular pitch of from 1 to 3 inches. These gears are used for coal-hoisting engines and machinery of a similar character, which generally run in situations where it is impossible to have a solid foundation for the machinery. The cast iron is a good quality of foundry iron, but no special pains are taken to get an extra quality, and it represents iron which can be obtained at ordinary foundries without difficulty. Our experience corresponds with the statement made by Mr. Suplee, that the face of a gear, beyond a certain width, does not add to its strength; it adds to its durability, but not to its strength to resist stress.

To illustrate this by a practical example, which is typical of our experience, take the case of a pair of cast-iron spur gears, with twenty-three and seventy-nine teeth,

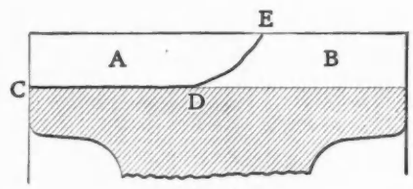

Fig. 1

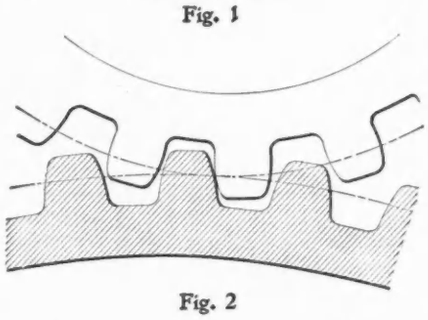

Fig. 2

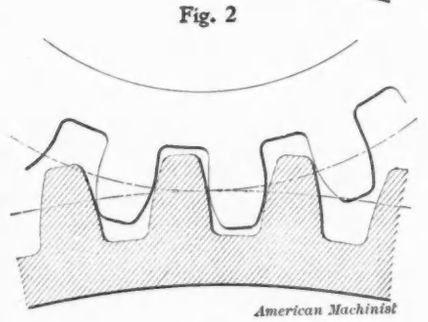

Fig. 3

2 inches pitch, 7 inches face, which failed repeatedly under loads which we know with substantial accuracy. The engine ran about ten days, when a tooth in the pinion broke. The break was along the line $C\,D\,E$, Fig. 1, the piece A breaking out. The part B of the tooth was left intact. The gear was continued in service, but in about ten days after, another tooth on the opposite side of the pinion broke, the piece breaking out being about the same size and form as the first one. The engine continued in service but a few days, when the remaining part of the tooth marked B in Fig. 1 failed. The pinion was taken out and a new one of the same material substituted. This ran about the same length of time as the first one, when one of the teeth failed in the same manner as the previous ones. A few days later the part B also failed, when a steel pinion was substituted, which stood the service permanently. As all of the breaks followed the line $C\,D\,E$ in Fig. 1, we can assume that the equivalent of this fracture fairly represents the width of the face which can be depended on for estimating the strength of the teeth of spur gears. This line $C\,D\,E$, we estimated, was equivalent to the strength of a tooth having a face equal to twice the pitch. From this test we may assume that, for the purpose of calculating the strength of the tooth of cast-iron gears, the width of the face should be taken equal to twice the circular pitch. The teeth failed with a load of 10,000 pounds on the tooth, which brought a fiber stress of 3,800 pounds per square inch on the metal at the root of the tooth, assuming in the calculation that the tooth was a cantilever with the load on the end. As we had five breaks in succession where the load was known with reasonable accuracy, we have assumed that 3,800 pounds fiber stress represents the breaking strength of a cast-iron gear tooth in this kind of service. The teeth of the gear wheel did not fail; hence, as the teeth of the pinion are weaker than those in the gear wheel, we may omit all consideration of the larger gear in computing the strength of the teeth.

A few years ago Mr. Michael Longridge, of Manchester, England, made prominent the defects of long gear teeth, and recommended those much shorter than the general practice. This was so radical a departure that, while it appealed strongly to reason, it was some time before I could decide to recommend a change of our proportions and make the short teeth which he recommended. In using short teeth it is necessary to make the strength of a single tooth sufficient to carry the whole load, and abandon the principle of having more than one pair of teeth in action at all times. We eventually tried the experiment of shorter teeth, and the results were exceptionally fine. They ran more like cut gears than like cast ones, and were obviously much stronger. We use the proportions shown in Fig. 2.

By comparing this with the usual proportions shown in Fig. 3, the difference in the length, and consequently the strength, will be seen. The strength of the two forms is in inverse proportion to the length of the teeth, or as 100 is to 150.

Two cases usually arise, one where the load is variable but the maximum load is known, and the other where the working load is substantially a constant amount. For the first case a fiber strain of 2,500 pounds and for the second a fiber stress of 2,000 pounds gives excellent results.

The clearance is necessarily larger than for cut gears, and is larger in small than in large gears, which we consider necessary, as gears are not usually absolutely round and also have slight irregularities on the points and on the bottom of the teeth, which are comparatively greater in small gears than they are in larger ones.

The most difficult problem was to decide just what proportion to use, and here engineers may differ as they give one or another factor greater prominence. The formula here given has been used for several years with ever-increasing satisfaction. In our design we do not use pinions having less than twenty teeth.

The length of the teeth and the clearance are intended to be sufficient to permit a slight variation in the castings arising from the difference in the shrinkage of wheels made at different times, and also to allow a reasonable amount for the wear of the shaft bearings without affecting the good working of the gears.

P, circular pitch in inches.
A, addendum.
D, dedendum.
F, face of tooth in inches.
C, clearance.
W = working load in pounds.
W', maximum load in pounds.

$A = .2\ P.$
$D = .2\ P.$
$C = .05\ (P + 1).$
$W = 1{,}320\ P.$
$W' = 1{,}650\ P.$
$F = 2\ P + 1.$

Table of the working load in pounds on a cast-iron short-tooth spur gear of twenty teeth. The last two figures in the result are approximate.

P. Pitch in inches.	W. Working load in lbs.	W'. Maximum load in lbs.
1	1,320	1,650
1¼	2,300	2,600
1½	3.000	3,700
1¾	4,100	5,000
2	5,300	6,600
2¼	6,700	8,300
2½	8,300	10,500
2¾	10,000	12,500
3	12,000	14,800

We use involute teeth only.

Mr. Wilfred Lewis also contributed some remarks to the discussion from which we extract the following:

In regard to the number of teeth in gear distributing the load, I am quite sure the methods of forming and spacing have not yet reached such perfection that it is safe to consider more than one tooth in gear. To obtain more than this, a variation in form or pitch can only be met by the elasticity of the tooth itself, which is a short stiff cantilever almost devoid of spring. Let anyone who doubts this conclusion, calculate the deflection of a tooth as a cantilever under its working load and then consider the possibility of construction with the degree of accuracy thus required. The steps in a series of equidistant cutters is far more than the spring of a tooth can begin to accommodate, and these steps represent the tolerated imperfections in form to say nothing of the difficulty of perfect spacing. In regard to the merits of short and long teeth it should here be said that short teeth cannot belong to the interchangeable class for which gear formulas, tables and diagrams are devised. Teeth for special purposes can be made as long or short as the special conditions will permit, but for interchangeable gearing, the standard proportions are about right and cannot be departed from without encountering serious difficulties in extreme cases.

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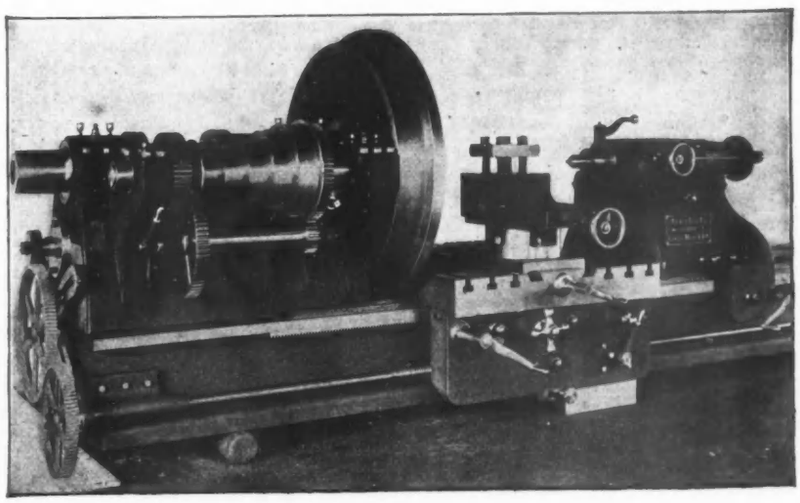
New Arrangement of Gearing for Lathe Headstocks.

We illustrate herewith a lathe by the Fifield Tool Company, of Lowell, Mass., which has a novel arrangement of driving gearing designed to give an increased number of speeds, and especially to give speeds suitable for small work when for any reason it is desired to do such work in the machine.

The machine will be seen to have the usual back gear and internal gear on the face plate, and in addition to this, a pair of gears of equal size upon the cone spindle and the main spindle, these gears being connected together by an idler not shown in the picture, which is arranged for throwing in and out of mesh by sliding endwise. The pinion meshing with the internal gear on the face plate is formed on the end of a sleeve which slides endwise upon the cone spindle from which it is driven by a feather. The endwise movement of the sleeve by which the pinion is drawn within the bearing and out of mesh with the face plate gear, is by a yoke engaging with a groove in the sleeve, the yoke being operated by the rack and pinion seen between cone pulley and face plate.

There will thus be seen to be four arrangements of gearing, first through the gears on the cone and main spindles giving the latter the full cone speed, second through these gears and the back gears, third through the face plate gear with the back gear out, and fourth through the face plate gear with the back gear in. As the cone will be seen to have five steps, it follows that, in all, twenty speeds are provided.

The lathe is made of both 64-inch and 72-inch swing, which are sufficient for most locomotive driving wheels, and the full complement of speeds is intended to fit it more especially for railroad repair-shop use.



20-SPEED LATHE HEAD.

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Continuous Marine Engine Records.

Continuous records of the performances of steam engines, marine and other, have long been a desideratum, and many devices more or less unsatisfactory have been proposed for securing them. A scheme for the purpose is proposed in a paper by Professor W. F. Durand in the "Journal of the American Society of Naval Engineers." The author determines the relation between mean effective pressure and initial pressure and vacuum with a given engine by preliminary calibration trials. Maintaining a constant vacuum, he takes cards at varying initial pressures and plots the values of the mean pressures obtained. He repeats the process with different amounts of vacuum. As the values so plotted fall in straight lines, a few points only are required. On the trial of which a continuous record is to be obtained no cards are taken, but readings of steam-pressure, vacuum and revolutions are noted by an observer at quarter-minute intervals and afterwards plotted on a time basis. By means of the information obtained on the preliminary trial the power at any given period can be estimated from the values of steam pressure, vacuum and revolutions, and a very close approximation to the true mean power developed during the whole time can be made.

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The L. S. Starrett Company, of Athol, Mass., announce that they have opened an office and salesroom at 126 Liberty street, New York City. Mr. A. H. Briggs will be in charge.

Machine Photography.

BY J. LANDSING.

The various merits of photographs to show machinery and their operations, are well established; but how to obtain good photographs for the purpose, is a different matter. Both the machine manufacturer and the photographer have their respective difficulties to contend against. The successful and continued maintenance of photographic departments in many well-known machine manufactories, seems to demonstrate that where a large variety of machinery is made, a well-regulated photographic department pays.

First of all, a photographer should know the optics and chemistry of photography. He need not know the derivation of the formulæ from which the curves of his lenses are obtained, but he should know under what conditions his lenses would distort or exaggerate the perspectives in the projected image. He should know every possible way in which his lenses and camera may be used, and all the so-called tricks that can be played with them. He need not be able to write the reaction of each operation in the dark room, but he should know positively the effect of each chemical which touches his plate or print. By the perfect mastery of his instrument he would be able to correctly judge what is the best exposure he can make and how to make it, under different conditions as to light and shade. This is the most important factor in machine photography, where the choice of light and position is often not to be had, as in a gallery operating room. Often a machine must be photographed just as it stands, perhaps in a dark corner of the shop, closely surrounded by other heavy work. When the exposure is doubtful, better care and skill must be used in development, to bring out all there is on the plate. The lens for the work should have great depth of focus; speed is of secondary importance. For most machinery a lens of from 10 to 12 inch focus is most convenient. A much longer focus lens would require too much space to be cleared between the camera and the machine. There should be a wide angle lens in the outfit. It will be necessary when space is limited. The wide angle lens should not be used unless absolutely necessary, as it is easy to exaggerate the perspectives by its use. The camera should have a long bellows. The tripod should be heavy and have telescope legs, and all joints should be tight. Sometimes it is necessary to locate the instrument on or among machinery or their parts when the telescopic legs will be found very convenient. Too much care cannot be used in preparing the machine and its surroundings for photographing. All oil and grease should be cleaned off. Each minute depression in the surface of the casting is an oil-cup, the surface of whose contents reflects the light like a mirror and gives a glaring spot. Where light is not reflected, the oiled surface shows a distinct spot, darker than the rest. All iron castings should be coated with a dull slate-colored paint, and be allowed to dry thoroughly. Should oil spots show through the paint, a judicious rubbing with chalk dust will almost always hide them. If polished surfaces reflect the light badly, they should be coated with white-lead and turpentine, or atomized with a thin whitewash. For a background nothing is better and more convenient than a large piece of unbleached cotton cloth, hung loose and kept in constant motion during exposure. The cloth need not be stretched smooth or be clean and white. Motion may be imparted to the cloth by shaking it by the edges or striking it in the back or front. The setting or floor must be cleared of everything, and, if possible, skids and rollers taken from under the machine. The floor must be covered with some white material, such as whitewash, sand, ashes or sawdust. No general rule can be applied to the plate and its manipulation; it is not the plate which is richest in silver nor the cheapest which is best. It is not so much what plate is used, as the thorough mastery of some one plate. It is better to use one plate, than be constantly changing to different plates for different purposes. The foregoing may be applied to developers. It is well to use the developer recommended by the maker of the plate one uses, but it is better to master one good developer which can be used with all plates. As to the exposure, it is indefinite to say give a long or a short exposure; there are so many conditions to be considered, that half an hour may be very short for one case and half a minute very long for another. It is safer to follow the cook books and say, "Cook till tender," viz., expose till you get good detail in the shadows and let the high lights take care of themselves. In properly developing an exposed plate, the operator should first know the effect of each ingredient of the developing fluid on the plate. In general, the developing fluid can be separated into three parts—the developer, accelerator and color giver. Sulphite of soda is generally used for the last. An alkaline solution like ammonia or carbonate of soda or potash is used for the accelerator; the developers are various. The proportion of the color giver and the accelerator should be kept constant, once determined by test to give the desired color to the negative. The developer should be varied to suit the exposure in direct proportion to the amount of time. The machine negative should not be very strong in contrast, but should contain all details in the shadows, especially for blueprinting, therefore weaker developer must be used for the time than otherwise. As a general rule, use a small quantity of developing fluid rich in developer for long exposures, and a large quantity of fluid weak in developer for short exposures. By long exposure is here meant, when the high lights are likely to be solarized. The acid fixing bath in an upright tank is the best. Should it be necessary to reduce the negative, immediately after fixing, before washing, place it in a weak solution of red prussate of potash till the proper density is obtained. This does not stain the plate. An under-exposed plate is almost useless; it is better to sketch in the details with the retouching pencil than anything else, if it is not possible to get another exposure. If the negative is to be used frequently, a coat of varnish will afford some protection.

The question of prints is not easy to answer. It is hard to get a brilliant blueprint with good details; but a blueprint has the advantage that it can be folded and sent in a letter, or otherwise roughly handled, with little injury. When blueprints are desired, use a slow printing paper richly coated. A silver print gives the best impression from the negative, but when mounted on card, is bulky to handle and file away, and is easily broken in the mail. If unmounted, the silver print goes to pieces at the first folding. If silver prints are to be used it is better to mount them on cloth, and straighten them by pressure. A silver print on plain salted paper may be a compromise between the two. When it is necessary to photograph a machine and daylight is not available, place a lighted candle at the farthest point of the machine, one at the nearest point, and two at the extreme edges; ignore the machine, and focus on the candles. A good flashlight is wanting in the market. A good flash-powder is preferable to the magnesium lamps available for machine work. Estimate the amount of powder necessary; divide it into three parts; sprinkle each part into a long, narrow line; flash each part separately, two flashes on one side of the camera and one on the other.

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The Old Shop.

"I have ever felt the want of it myself [technical education] and have admired it in others; but for all that, I have a most kindly feeling for my 'Alma Mater,' the old-time country machine-shop, of which to-day there lies not one stone upon another. Not one sodden timber rests in the forebay, and only the notched recesses cut in the rocks on the river bank remain to show where the old water-wheel once slowly turned on its well-worn gudgeons; and much as I admire the grand engineering-schools of to-day, now that the hard toil of my youth is over, I look back to the old shop with a thankful heart, that amid its grime and dirt, amid its hard work and unpaid services, I learned of patience, of perseverance, of self-reliance, and handicraft; and above all, I learned under most trying and discouraging cir-

cumstances to close tightly my lips together and inwardly vow that I would make it go, somehow."—J. F. Halloway.

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Trimming Wrench Blanks.

BY W. A. WARMAN.

Having several thousand wrench hammers to round up and straighten on the back, I found it necessary to find some method speedier and cheaper than milling. The hammers, being forged, had the usual fin, and this had to be gotten off. The arrangement shown in the photograph is what we used. Fig. 1 in the sketch shows a section of bed and cutters and an elevation of the punch or slide. The bed has the inclined grooves to receive the cutters *A A*, which are held in place by the clamps *B B*. Adjustment is obtained with the wedges *C C*. The punch *D* has the hardened steel piece *E* secured by cap screws. Spring clips *F F* held by one of the screws on each side, hold the work when it is placed in position. Figs. 3 and 4 show sections and plans of cutters used. The serrated cutters are used to take a roughing cut, after which the work is passed through three times with the plain cutters, the last cut being set to take not more than .0015 inch, at a cutting speed of 11.66 feet per minute. This speed seems slow in face of the fact that the corrugating, described in a previous article, was done at a speed of 29.16 feet per minute.

I can see no reason why this should be so. I know, as a matter of fact, that we could not get satisfactory results at what would seem only a moderate cutting speed.

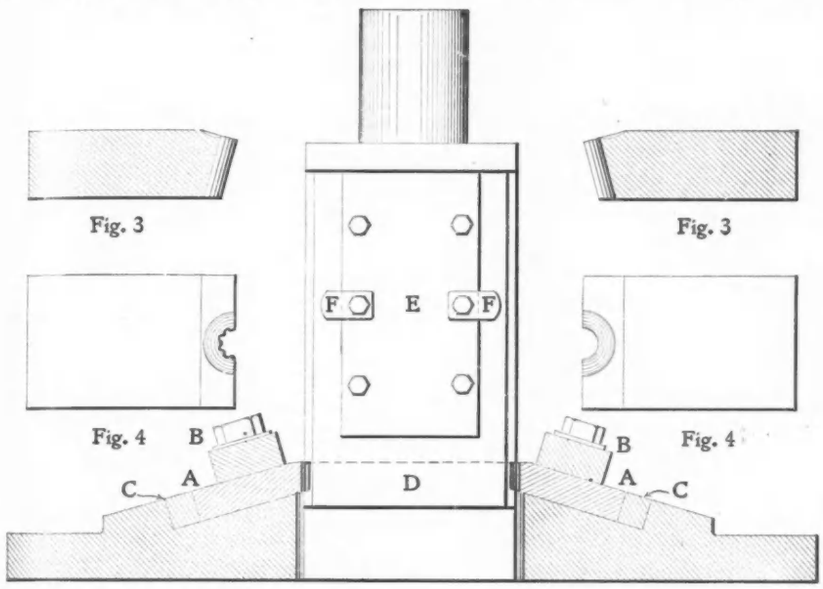


Fig. 1

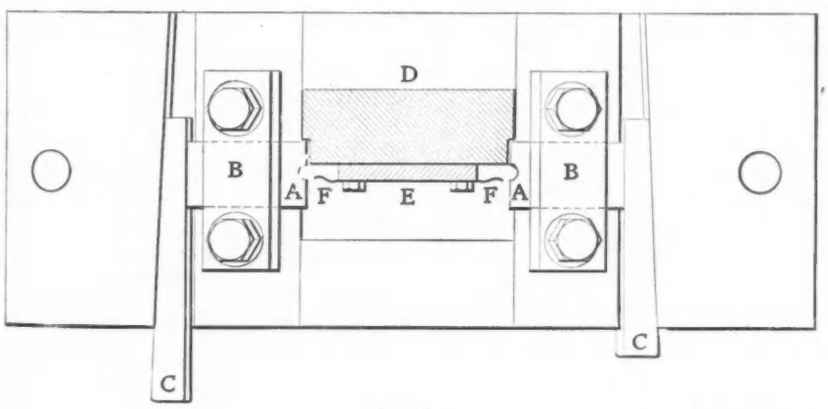


Fig. 2

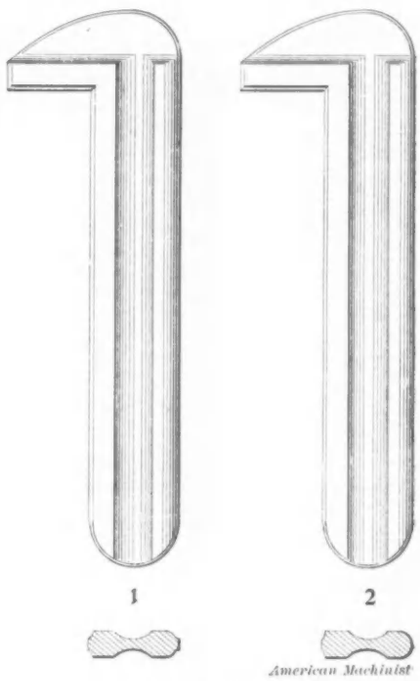
American Machinist

DIES FOR WRENCH BACKS.

The cutters require a clearance of 2½°. It is not absolutely necessary to set the cutters at an angle as shown, but it makes them easier to grind and keep in order. The best results were obtained with a very slight top rake on the cutters, not more than the concavity that a four-inch wheel would grind. Too much rake is worse than none.

We used several grades of steel for cutters and found very little difference when properly hardened. I got the best results by heating in gas and hardening in water at 78° to 80° F. and finishing the cooling in vaseline, without drawing, using plenty of cyanide. Do not depend upon the cynanide to do the hardening, but heat your steel as hot as the quality of steel will stand without damage.

I trust the reader will pardon me if I digress and ride my pet hobby a lap or two, but the subject of hardening and tempering this class of tools is one which should receive more attention. I find that the average blacksmith does not appreciate what is required of a tool of this sort. He always knows just what you want, and usually does just what you don't want. He will concoct solutions, with all the gravity and mystery of a "voo-doo" doctor, when pure water will do better. Solutions without a proper heating of the steel are deceiving; they only case-harden. A tool for heavy duty must be hardened through. If the right degree of hardness can be obtained without drawing, so much the better. This is not so hard to do as it seems. Clean water at the right temperature, a good heat in charcoal or gas, time enough in the water to secure sufficient hardness, then a quick transfer to a heavy bodied oil to finish cooling.



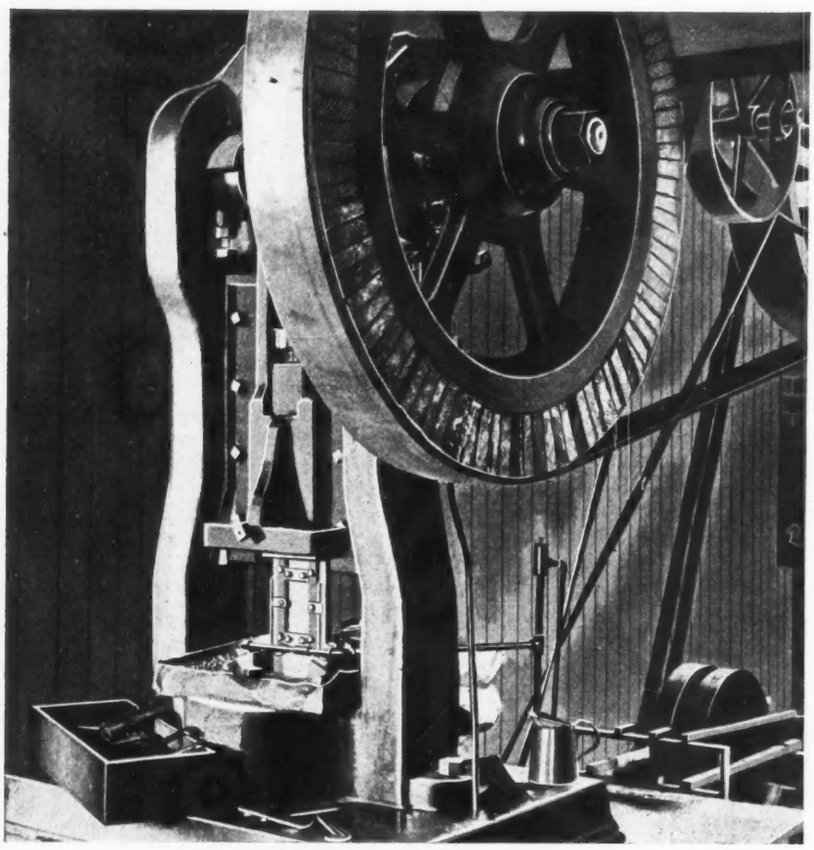
American Machinist

ROUGH FINISH.

To get back to the wrench job: lubrication is a feature that must not be overlooked. I used a heavy solution of vegetable oil, soft soap and water, 5 pounds of soap to the gallon of water. This did better work than oil, the supply being at about 15 pounds pressure, through ⅛-inch nozzles attached to the supply pipe shown in the photograph.

I have no apology to make for the lagged-up press fly-wheel, except for its appearance. Aside from its lack of beauty,

it was highly satisfactory, and did not cost to exceed $4. It would pull more than we could ever get out of the 4½-inch double leather belt. We made the steel band, planed up some 1½-inch stuff to the shape for the segments, wedged between the segments and the pulley with shingles, cemented on a crown of paper, and the "old man" was "in" the price of a new pulley.



TRIMMING WRENCH BACKS.

On the Construction of Armature Cores.

BY WM. BAXTER, JR.

In the early days of electrical development, armature cores were made either solid or of iron wire coiled into the proper shape. When solid, they were generally of cast iron, as in the old Brush machines. Wire cores were considered to be the best, from an electrical standpoint, but were regarded as defective, mechanically, owing to the difficulty of making them sufficiently rigid. Some manufacturers sought to overcome the mechanical weakness by using tinned or galvanized wire, which was sweated together so as to convert the ring or drum into a solid mass. Wire cores were regarded as superior to solid ones, because previous experience with induction coils had shown that a bundle of wires would give better results than a solid rod; and the conclusion generally derived from this fact was, that iron, when subdivided in the form of wire, could be magnetized stronger than when in a large mass. Soldering the wires together was not supposed to be a defect, because the real advantage of subdividing the metal was not understood. A wire core gives better results than a solid one, not because the wire has greater magnetic capacity, but because it reduces the strength of the electric currents generated in the core. When an armature revolves in a magnetic field, electric currents are generated in every part where there are complete circuits in which they can flow. The paths of the currents will be in lines parallel with the shaft, except at the ends of the armature where the circuits turn around to reverse their direction. As the wire of the core is wound at right angles with the shaft, the currents in the core must run across the wire, and therefore have to overcome the resistance of the imperfect contact of the adjoining wires, which may be very high if there is a considerable thickness of rust or scale on the wire. If the wire is galvanized, however, and formed into a solid mass by means of solder, the resistance at these points of contact will be obliterated, and currents will be able to flow through it about as freely as if it were a solid piece of iron. On this account the cores in which the wire was soldered together, were inferior to those made of black wire, although superior from a mechanical standpoint. The best of wire cores, however, are very defective, owing to the fact that they only remedy in part a defect that must be entirely removed to insure satisfactory results. Wire cores will work in small machines, although with a very low efficiency; but in the large generators of the present day, they would fail entirely. In a large generator, the magnetic field is so strong that the electro-motive force developed in a single turn of wire on the armature is sufficient to drive a very large current against a low resistance, and as this same amount of pressure could be developed in a circuit in the core itself, it follows that the construction must be such as to make it possible to obviate such circuits. With wire this cannot be accomplished unless an insulating covering is used, and this would be objectionable, as it would increase the cost of construction and weaken the structure mechanically.

In modern machines the armature cores are made of sheet iron, which is superior to wire from the fact that, with it, the insulation can be made perfect, and in addition to this, the core can be made with grooves—a construction which is very desirable in the majority of cases, and which is not possible with wire cores. In sheet-iron cores the construction must be such that the sheets run at right angles to the direction in which the electro-motive force is developed. If the armature is arranged with the poles of the field around its periphery, the core must be made of disks or rings mounted at right angles with the shaft. If the poles are placed on the sides of the armature, the iron must be wound around like a coil of ribbon. This latter construction is not used very often, as it presents greater constructive difficulties.

Small armatures are made either of the drum or ring type; but for large machines, the core is always of the ring type, whether intended for a ring or drum winding. The only exception to this rule is when the machine is of the two-pole kind; but large two-pole machines are not made at the present time.

For small armatures, say 8 inches in diameter, or less, the disks or rings are punched in one piece, of iron, ranging from 24 to 26 gage. For a drum armature, a thin sleeve of hard wood or paper is slipped over the shaft, and the disks, which have a hole large enough to fit over this sleeve, are strung on it and tightened up endwise of the shaft by means of a stationary flange at one end, and a nut and movable flange at the other. The iron disks are separated from each other by sheets of paper, which, by some manufacturers, is stuck to the sheet iron before the disks are punched out, and by others is cut independently of the iron. If cut independently, the iron and paper disks are placed alternately upon the shaft. The object of the paper is to separate the iron disks, so that there may be no path for the current to pass from one to the other. The wooden or paper sleeve between the disks and the shaft affords insulation at this point, and at the ends

the disks are separated from the heads by a piece of fiber or a sufficient number of sheets of paper. As the magnetism has a strong tendency to twist the armature core around the shaft, it is necessary to secure it against rotation. This is accomplished by passing two or more bolts, or rivets, through the disks, parallel with the shaft. These bolts are made somewhat smaller than the holes in the disks, and are covered with cloth well fastened on with glue, or else with a sleeve of fiber; thus metallic contact between the bolts and the disks is prevented. These bolts hold the disks firmly to the heads, from which they are also insulated, and the latter are prevented from revolving on the shaft by means of keys.

If an armature is built up as explained in the foregoing, there will be no metallic contact between the adjoining disks, unless it is caused by burs from one overlapping onto the other. These burs may be produced in two ways—one by punching the disks with a die that is dull or an imperfect fit, and the other by the process of truing of the outside surface. The first can be prevented by using a properly constructed die, and keeping it sharp, so that it will make a clean cut. To prevent burs from lapping over from disk to disk, when the outside is trued off, it is necessary that the paper separating the disks be of a dense quality, first-class manilla, and that it be rendered as hard as possible by being well soaked with shellac, and screwed up as tightly as the nut on the shaft will permit. If the trueing up is done in a lathe, with a tool, the last cut should be very light, and with a very keen edge. If then a smooth file is used, the bur will be entirely removed. A cheaper and better plan, however, is, to grind the surface true, finishing the work with a fine emery wheel. As the paper between the disks is not over two or three thousandths of an inch thick, it will be realized that unless considerable care is exercised, all the burs will not be removed. Shellac should not be applied to the paper before the disks are put in place, as it would be very apt to dry in ridges, and these would prevent the balance of the surface from coming into contact. The proper course of procedure is to place all the disks in position, and while they are in a loose state apply the shellac freely to the whole surface of the core. The varnish will soak in to a depth of an eighth of an inch or more, which is all that is necessary, as the amount taken off in truing the outside is seldom over one-fifth of this. The disks should be tightened up as soon as the shellac is applied, so that it may not have a chance to set, and prevent them from coming as close together as they should. The core should be allowed to dry for several days, or else be baked at a moderate heat for two or three hours, before the surface is trued off. If this precaution is not taken, the paper will be pulled out of the joints, to some distance below the surface, on account of being softened by the wet varnish, and if this occurs, there will be nothing to prevent the burs from lapping from one disk to the other. If the varnish is allowed to become thoroughly dry, the paper will assume a horny consistency, and will not be cut away to any greater depth than the iron; therefore, it will hug close to the sides of the disks all the way out to the surface, and thus prevent the formation of burs.

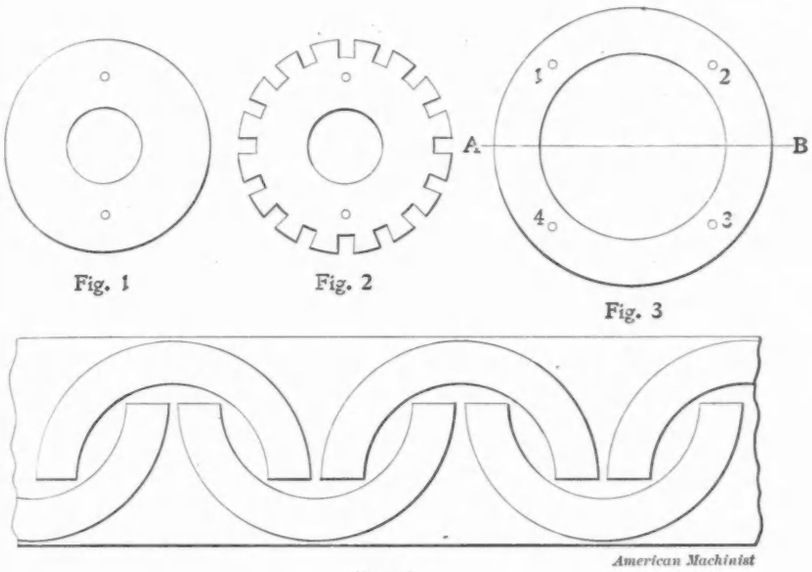


Fig. 1 Fig. 2 Fig. 3

Fig. 4

CONSTRUCTION OF ARMATURE CORES.

The construction of cores for ring armatures differs from that above described only in the manner of fastening the rings together. In the case of a drum, as there is no open space between the core and the shaft, the disks can be clamped together by means of heads secured to the shaft, but with the ring a sufficient space is left between the shaft and the inside of the core for the wire to pass through. On this account the core is made complete within itself, and is then held in its proper position upon the shaft by means of a spider. The disks of a drum armature core may be shaped as shown in Fig. 1 or Fig. 2; while for a ring core they would be as shown in Fig. 3, or with grooves on the outside the same as Fig. 2. As the ring core cannot be clamped between heads mounted directly upon the shaft, it is constructed with end rings made of wrought iron, of sufficient thickness to give the required strength. For a smooth core, as shown in Fig. 3, these rings would be the same diameter, inside and outside, as the sheet-iron rings, and would be provided with holes, 1, 2, 3, etc., to match holes in the latter. Through these holes rivets would be passed to hold the structure together. In grooved cores the end rings are almost always made of the same diameter on the outside as the bottom of the grooves, and sometimes a trifle smaller.

In the construction of drum armature cores, especially of small size, there is little room for the display of ingenuity, since it is quite evident that the course outlined in the foregoing is about the best that can be adopted. With ring cores, and specially if of large size, this is not the case. If the ring shown in Fig. 3 were, say, 4 or 5 inches in diameter, it would be quite evident that the cheapest and best way to make it would be to punch the ring out in one piece, as by so doing the core could be made perfectly rigid with smaller and more imperfectly fitting rivets than if the sheet-iron rings were made in halves. The dies for cutting out the blanks would also be less expensive. If the armature were grooved, it is doubtful if the dies would cost less than those for the half ring. The waste of material in cutting out the ring would be much more when in one piece than if in two, as can be seen from Fig. 4. This saving in material is not a very important matter in armatures of a few inches diameter, but becomes serious as the size increases. It may be a debatable question as to whether anything can be saved by making a core 6 inches in diameter of segments instead of solid rings, but if the diameter is 30 inches, the advantage of using segments becomes quite evident, not only on account of the saving in sheet iron, but also on account of the difference in the cost of dies. When the diameter passes beyond 30 inches, we soon reach a point where we are compelled to use segments, from the fact that sheets of iron of sufficient width for a whole ring cannot be obtained. As may be expected, there is a difference of opinion as to the diameter at which it is profitable to change from solid rings to segments, and there is also a difference of opinion as to the

number of segments; but, with few exceptions, armatures above 24 inches are built up of segments. In the next article the method of constructing such cores will be fully explained.

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Letters from Practical Men.

Fire Pails—Authority and Discipline.

Editor American Machinist:

It is not worth saying that fire pails are very necessary and important things. A fire pail—with water in it—is sometimes worth more than a dozen fire engines and a big chief ten minutes later. In establishments of any size and importance, and with any ideas of permanent continuance, you are always sure to see the rows of fire pails set around at convenient points. That is all right, although I am not quite sure that the pails are quite complete without a gage glass in the side of each to show how much water is inside. The gage is as necessary as on a steam boiler, and more so, because I have an idea that low water is more frequent in fire pails than in steam boilers. I certainly have heard of fire pails with very little water in them and sometimes also of pails entirely empty.

But here is the remark that I want to make. There is a sight that I often see that never fails to fill me with disgust and indignation to the point of explosion, and that is the fire pail or a row of fire pails with hemispherical bottoms to them. Human ingenuity, if you call it ingenuity, was never more abominably employed than when getting up that pail. The sparsity of common sense was never more completly evidenced than in the extensive and numerous adoption of that pail. Wherever I go I am apt to see it, so that enormous numbers of them must be scattered over the land. If they are patented there must be money in the patent. The makers of them must have got rich; but never were riches more undeserved.

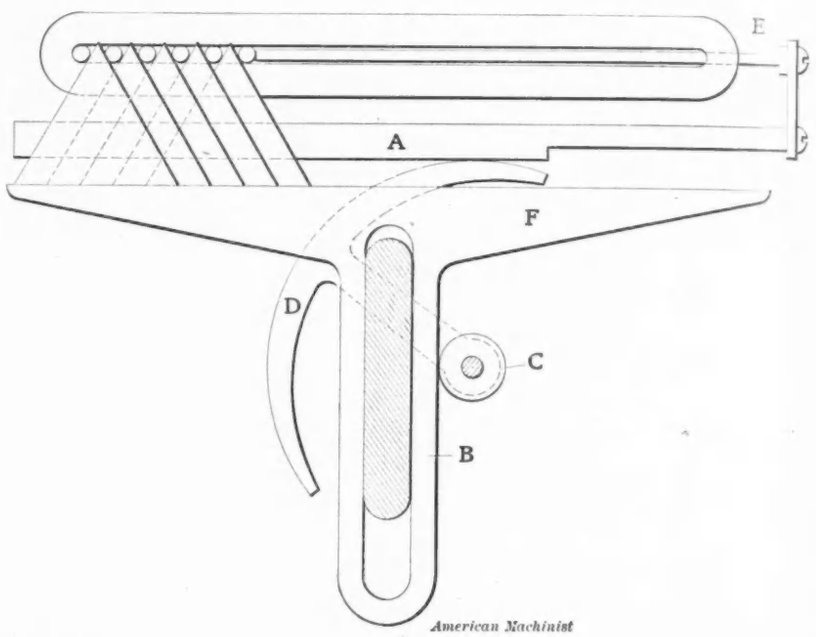
The idea on which the pail is made and sold, and painted to its dazzling red and set up in its glory for underwriters to worship, if they are so benighted, is evident enough. This fire pail must be the best pail in the world for fire service because it is good for nothing else. They say that boys are sometimes assigned to their stations in life on the same general principle, and it is just as proper in one case as in the other, improper in both.

The thing that is sought to be accomplished by the use of the hemispherical bottom of the fire pail is certainly secured. The pail is emphatically let alone. When anybody wants a pail of water he wants to set it down somewhere, and if the water is to be used it is not all to be used at once. It is a rare thing in ordinary shop life that one wants a pail of water to throw all in one splash. It is still rarer that a fellow wants to stand and hold a pail of water for fun. One or the other has to be done with this kind of a pail or it has to remain in the rack; so it remains. Everybody lets the pail alone, and the letting alone is the only common sense operation connected with the pail.

The whole object of making the pail with the round bottom is to insure that it will always be there when it is wanted, and that object is accomplished. It does not help in the least about providing or insuring a pail always full of water when wanted. The latter is just as important as the former; so that, after all, the job of securing an ever-ready pail of water is at best only half accomplished. The pails are there, but is the water? As they will be let so completely alone, and as they can't be stood anywhere without tumbling over, it will not be so easy to fill them as the ordinary pail; so that, other things being equal, the chances are that they will be less likely to be found always full than if they were common, everyday sensible pails.

But the great objection to the pails, after all, is that they have so many bad points about them, even for fire service. The ready ability to tumble over and spill every drop is anything but a virtue in the excitement of a fire. There are often other things very necessary to do in extinguishing a fire besides throwing a pail of water; but the man with one of these pails is helpless. He can't pry off a board to get at the fire; he can't chop down anything; he can't set down a pail and use a dipper to throw the water; he can't handle anything—he is tied to the pail. Another fellow can't bring a pail and set it down and run for another. Nice things these pails are for a watchman alone in the middle of the night.

The adoption of these special fire pails in a shop tells a shameful thing. It certainly tells of the lack of proper organization or of proper authority in the shop. Those pails say plainly that, while fire pails are very necessary, there has been found no means efficient to secure so small a thing as an ever-ready array of a dozen or a hundred pails, and these other things have been set up as monuments of failure. If they don't mean that, what do they mean? If anyone can argue or pretend that they are the best pails for fire use, while they are the worst possible pails for every other use, I would like to take some lessons in that style of reasoning, just for curiosity. If I was a proprietor of an establishment rigged up with a lot of those pails, I would have to hang my head in shame as I walked through it, for the pails would be a dead give-away on my intelligence or my discipline.



TECUMSEH SWIFT.

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That Special Mechanical Movement.

Editor American Machinist:

Mr. Hunziker's solution of this problem in the issue of July 22d interested me, and I submit sketch which I think will overcome the objection which you mention in your editorial comment on the same, viz., that he could spread the points, but could not draw them together again. My sketch is practically the same as Mr. H.'s, with the addition of the push rod *E*, that enters the slot for guiding the pins, and rests against the last pin, and also the two racks *A* and *B*, the pinion *C* and segment gear *D*. As the T-shaped piece *F* is pushed up to force the triangles between the pins, it rotates the pinion and gear, so as to cause the rod *E* to be withdrawn from the slot, and thus make room for the advance of the pins; the rod *E* and

rack *A* being fastened rigidly together, and moving as one piece. On reversing the motion, the rod *E* is pushed into the slot, while the piece *F* is withdrawn to make room for the triangles.

The number of teeth in the complete gear of which the segment *D* is a part, would be found by multiplying the number of teeth in pinion by the base of one of the triangles and dividing by its altitude, and then multiplying this by the number of triangles used. At first I was under the impression that the diameter of the pins would have a very slight influence on the required ratio of gearing, but on second thought have concluded that this was not a factor.

WALTER GRIBBEN.

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The Corliss Horizontal Drilling Machine.

Editor American Machinist:

I want to thank Mr. Randol for his article on horizontal drilling machines, which appeared in your issue of April 15th, and especially for his resuscitation of the Corliss machine. Fifteen or sixteen years ago I was quite well acquainted with the old De Lameter Iron Works, and that machine always excited my admiration. For a large range of medium heavy work it performed its functions in a more satisfactory manner than any machine which I have ever seen, and this in spite of the fact that it was in some respects badly designed, the location of the cone pulleys being especially awkward.

One prominent use to which they put it was for drilling the bolt holes of cylinder and steam chest flanges. The cylinder feet being first planed, the casting was strapped to the table which ran upon a horizontal track, when the holes in the flange could be reached without any waste of time. The arrangement was also very convenient for facing off the nut seats on the back sides of the flanges. Frame flanges and pillow blocks—the former being shown in Mr. Randol's illustration—and many other similar jobs were done in a more expeditious manner than I have ever seen them done elsewhere.

Another use of the machine not shown in Mr. Randol's picture was for a boring machine. At the time of which I speak the De Lameter works made a good many air compressors, in which each cylinder head contained a nest of valves. These cylinder covers were bolted to an angle plate and a support for the outer end of the boring bar was secured to the table beyond the piece of work being done. In this way the different holes were reached in a very expeditious manner, especially in cases where the cylinder heads were large and heavy, as they often were.

Mr. Randol says this machine was not arranged for tapping, but I am not sure that it was not so used. At that time the De Lameter works had a reversible tapping fixture which was the first of this kind that I remember having seen. It was used on different drill presses, and it would be strange if it were not applied to this machine when occasion required.

C. O. GRIFFIN.

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A Lathe Tool—Compound Rests on Small Lathes.

Editor American Machinist:

I think the following may be of interest to your readers:

Some years ago, an old engineer who had learned his trade away back in the forties or fifties, gave me a good wrinkle

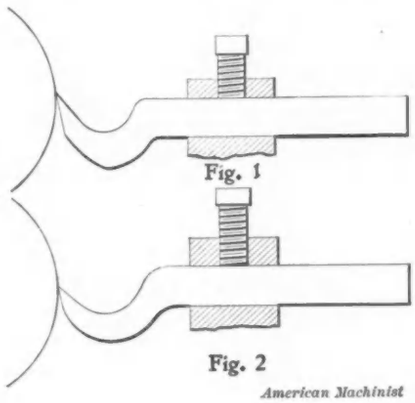

Fig. 1

Fig. 2

American Machinist

on how to make a turning tool which I have never known to fail its purpose. With the ordinary way of making tools, when they have to be used set a long way out from the rest, as in turning a crank, the turner has to be very careful to avoid digging in, with the result of either breaking the tool or spoiling the work. Ordinarily tools are made with the cutting point level with the top of the tool (see Fig. 1). Fig. 2 shows the old engineer's way, the cutting point being just above the center of the piece of steel the tool is made from. The reason is plain. When the tool bends under pressure, its point describes an arc whose center is about the center of the piece of steel, not the top surface. In Fig 1, the point will bend with the work, and in Fig. 2 will bend away from it. There are other advantages about the tool in Fig. 2. One is that it need not be made of such heavy stock as is necessary with that of Fig. 1.

Mr. Miller seems to be very much against compound rests on small lathes. I wanted a small foot power lathe some time ago for use at home, and think that I shall have to buy an English one, although I would prefer an American one, as they are not so heavy; but how can I hore a taper hole without a compound rest? I should be sure to want to do this some day.

Your paper is very interesting and I have introduced it to several people about London who I believe are now buying it every week. They are principally foremen of engineers' shops, etc.

ALFRED CLEGG.

London.

[Our contributor does not seem to be acquainted with the American taper turning attachment, though perhaps he wants a smaller lathe than they are applied to. At any rate we advise him to acquaint himself with it. Besides, there are several foot lathes regularly made here with compound rests.—Ed.]

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The Lightest Known Solid.

The lightest known solid is said to be the pith of the sunflower, with a specific gravity of .028, or about one-eighth that of cork. The sunflower is extensively cultivated in central Russia, and various uses are served by its different parts, the recent discovery of the lightness of the pith essentially increasing the commercial value of the plant. For life saving appliances at sea, cork has a buoyancy of 1 to 5, while with the sunflower pith 1 to 35 is attained. About 800 cubic inches of it would weigh as much as 1 cubic inch of iridium, the heaviest metal.

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As our readers know, our editorial rooms are in the top story of one of the modern sky scrapers, at nearly the hight of the top of the Bunker Hill Monument. Already this season we have had one or two lively thunderstorms playing about our ears, and on another building in the vicinity a flag pole was shattered in the last attack. It is probable, however, that the inmates of these buildings have not been in the least danger, the masses of steel having more attraction for the subtle fluid than the human body has, so we sit quietly, and with unruffled minds watch the flashes and the darting streaks. It would probably be unsafe, however, to stand on the roof when one of these storms is in business, and we do not propose to try it.

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The flow of steam of any pressure through an opening into any other pressure, less than three-fifths of the initial, has practically a constant velocity, 888 feet per second. The weight discharged per minute in pounds avoirdupois may be found by multiplying the area of the opening in inches by 370 times the weight per cubic foot of the steam.

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Baxter D. Whitney sends us a strip of white pine, 10 feet long, 2¾ inches wide, and originally 5-16 inch thick, which has been planed, at one passage through one of his planing machines, to a thickness of 1-64 inch. This thickness is uniform, and the surface of the wood is excellent. This specimen we consider a very interesting evidence of the degree of perfection to which such machines have been brought.

AMERICAN MACHINIST

Published Thursdays by

American Machinist Publishing Co.,
256 Broadway, New York.

John A. Hill, President and Treasurer.
C. A. Hansmann, Sec'y.

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Tools with Machines.

Machine tool design is largely a matter of adaptation to the methods and manners of the users of tools, and many an important alteration of design has been made as a result of the discovery that some hitherto unknown genius has, instead of following what the designer considered the obvious method, adopted one of his own for working the tool, which, whether better or worse, had to be provided for in future construction.

This phase of the business is of special importance when machine tools are sent abroad, for it can almost certainly be assumed that a machine tool used outside the United States will not be used in the same manner as it would be at home.

Many an American tool which is entirely successful here fails, or only partially succeeds in a foreign shop, for this reason only; and though in some cases there is no help for this except such as time and patience and the persistent carrying on of the educational process will bring, there are other cases in which there is some help for it.

For instance, suppose an American builder to have spent years in developing and perfecting a certain machine of the turret-lathe type. This design is almost certain to be mainly the result of a study of the methods pursued by users of the machine, and of the difficulties and limitations encountered by many different men in doing a wide variety of work. The tools and fixtures necessary to the successful operation of the machine have been developed in the same manner, and machine and tools together form one complete engine, neither portion of which can work as designed to work, except in company with the other. These, of course, are familiar facts, and for that reason it is the more to be wondered at that our builders, in many cases, send bare machines to foreign countries, where the tools and fixtures must be made by men who are absolutely innocent of all the special knowledge and skill necessary to make them properly.

It may be set down as a safe rule of practice, that, even where the tools for a machine seem very simple in character, at least enough of them should accompany every machine to show clearly how they should be made, and it would be all the better if some pains were taken to impress upon the user the fact that the tools sent do not merely happen so, but are the result of experience, and should be altered only after very thorough and careful trial, it at all.

If some of our American builders could see the tools made and used occasionally in foreign shops, they would better appreciate the importance of this point, and would also better understand why their machines in so many cases fail to work abroad as well as at home, or why they are worn out in half the time they are expected to last here.

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Mechanical Pace Makers.

Our columns show continually how completely we believe in the practical helpfulness of intercommunication between those engaged in mechanical pursuits, and how much also we are constantly doing to promote what is in itself, and in its results, so desirable. There are, however, many who will readily acknowledge some of the actual benefits resulting from mutual communicativeness who still fail to appreciate the full scope and influence of it. It is perhaps first in importance that we should each know all that we can of the best and most advanced means and methods of manufacture, so that the best facilities for doing things may be as widely adopted as possible. It is also important that we should know what standards of accuracy and excellence are maintained, so that each may do as well as, and strive to somewhat excel, every other, and yet avoid the unprofitable niceties which, though rare, still prove fatal stumbling blocks to the few. There can be, theoretically, nothing too good; but practically there may be, even in machine work, a finicality which no customer will appreciate, which none will willingly pay for, and which therefore will not pay.

But perhaps, after all, the most necessary thing for us each to know of the other, is the pace at which we are going. Isolated contentment is not the best developer of either power or speed, and if velocity is conceded to be desirable, there is no better way to promote it than by diffusing a knowledge of the general pace, and especially of the rate of every flier. We can have no greater stimulus than may be found in the fact that a rival is just a little faster. The greatest astonishment among our foreign competitors is provoked, not by the ingenuity of our automatic machinery, but by the speed at which it can be, and at which it actually is, operated. We can none of us do our best unless we are crowded, and the closer we are pressed, the better will be our speed. There must be a pace-maker, and neck and neck is very different from six lengths apart.

It is a rather curious fact that this actual knowledge of each other's speed can never work but in the one direction. The struggle is, always to be first and never to be last. The laggard never sets the pace, but merely gets left. The struggle to win stimulates to alertness in securing the means of winning. We have only to know that we must pull faster and that it can be pulled faster, as the other fellow is showing us, to also find the way to do it. Modern methods and modern successes have come more from mutual rivalry in full sight of each contestant than from all else.

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The Secretary of the Navy has taken preliminary steps toward the creation of a Board of Naval Officers to ascertain the cost of a government armor plant and to report to Congress at its next session. Two of the members of the board already selected are Commodore Howell, commandant at League Island, and Captain McCormick, of the Norfolk Navy Yard. The board are not only to ascertain the cost of a modern armor plant, but must also take into account the propriety, or rather the necessity of establishing also in connection with it a complete plant for the production of steel ingots. If it should be held to be absolutely necessary, as is done in the best practice to-day, to follow up the processes upon the ingot without allowing it to cool, the government will be obliged to establish a steel plant alongside the armor plant, and as

a part of it, if it is to embark successfully in the business of armor-making. Whether the Engineer Corps will be permitted to contribute any advice in the matter does not yet appear.

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An American who has been introducing a new machine tool abroad informs us that in some Scottish engineering establishments they refuse to even consider American references or testimonials as to the value of tools; so that, in some cases, the fact that his machine had been used successfully by leading establishments here had no weight whatever. In the absence of British references they refused to consider any. Does this result from differences in shop practices, which may make a machine tool good in one country and bad in another, or is it that we are too careless with our testimonials? Either or both of these causes might operate to produce the observed phenomenon.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(121) L. S. L. asks: If a ball be projected vertically from an open freight car, moving at a constant speed in a horizontal plane and in a straight line, where will the ball strike at the termination of its descent, assuming that there is no air resistance? A.—As the ball leaves the car, its velocity has a horizontal component equal to that of the car. The resistance of the air being ignored, this component will not alter, the ball will in its flight be constantly over the point of the car which it left and it will finally return to that point.

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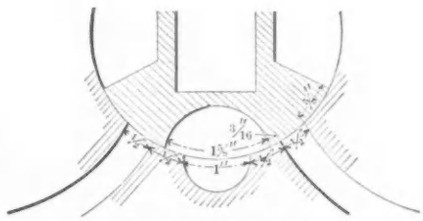
(123) J. K., Erie, Pa., has a 6½ x 10-inch threshing engine, running 180 revolutions per minute, which does not give sufficient power. He sends the following sketch of the valve, and wishes to know if it is well proportioned, and what can be done to increase the power. A.—The valve is laid out for a cut-off at about one-half stroke, and for this cut-off the travel, inside and outside lap, and the steam port are well proportioned. You can increase the power somewhat, at the expense of



Length of Ports 4¾"
Travel of Valve 1¾"
American Machinist

economy, by reducing the lap. Reducing this lap to 7-16-inch would make the cut-off occur at three-quarters of the stroke. If this change is made, the inside lap should be entirely removed. The eccentric will also require resetting—not changing the throw, but moving it around the shaft to give a proper lead, which will probably be somewhat more than at present, to compensate for the reduced compression. If your sketch of the valve seat is correct, the trouble lies in the shallow exhaust cavity in the seat. This cavity should have everywhere a cross-section at right angles to the flow of the steam, not less than that of a 1½-inch pipe. Many small engines are badly designed at this point, and we should suspect this to be the trouble with this one, were it not that the valve is so well laid out in other respects, which leads us to doubt the accuracy of your sketch at this point.

▲ ▲ ▲

Technical Books.

WOOD WORKERS' TOOLS. By Charles A. Strelinger & Co., Detroit, Mich. 396 6 x 8 inch pages; 2,253 engravings. Price, bound, $1; in pamphlet form on thin paper, 25c.

We have struggled with this book for some time in the effort to do it justice, but give it up. We had thought to give some sample extracts, but are embarrassed with a multitude of riches. We quote: "Headlines—We have refrained entirely from the use of big black type and startling headlines. There are so many good things in this book that if we undertook to emphasize their merits by bold-faced type, the pages would be as black as —"; which is exactly the reason why extracts are impossible. The book is properly a catalog of wood working machinery and tools, in which capacity it will be a revelation to most mechanics. With this it gives more information on its subject than we have seen between two covers before, while it sparkles with wit as the midnight sky with stars. We are almost prepared to say it is the best piece of mechanical literature that has appeared since "Chordal." For Sunday reading or every-day reading, it is equally appropriate. Get it and bless us for having called your attention to it.

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Personal.

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Obituary.

David W. Pond, the founder, and, for some years, president of the Pond Machine Tool Co., took his own life by a pistol shot on the morning of the 4th inst., at his home in Plainfield, N. J. Some time ago he disposed of his interest in the company named above, and had since been doing business in Wall street as a broker and speculator. It is said that he had been unfortunate of late and that his heavy losses had caused a degree of mental strain which he was unable to withstand. He leaves a widow and a young son.

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Permanent Exposition of Machinery in Peru.

The Consul General of Peru requests us to publish the following circular:

"The Peruvian Government, wishing to increase trade in the machinery and kindred lines with manufacturing countries, has decided to establish a permanent exposition of all classes of manufactured articles in the lines of machinery, giving preference to such as are mostly used in Peru, viz., agricultural implements, mining machinery, electrical appliances of every description and apparatus for labor-saving machinery.

"The Peruvian Government have never before given such inducements to foster

trade, and the facilities offered to American manufacturers are advantageous.

"All exhibits will be exempt from Custom House duties as well as from Consular fees. The Exposition will be inaugurated in December 9th next, at Lima, Peru.

"Exhibitors will have the option to show their wares for a period of six months, should longer time be required, arrangements may be made by applying to the officials in charge.

"Further particulars and copy of the rules and regulations with application blank will be cheerfully furnished by

"CARLOS G. ESTENOS,
"Acting Consul General."

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Casting Gears in Baked Molds.

BY GUS C. HENNING.

[In our report of the Hartford meeting of the American Society of Mechanical Engineers, mention was made of Mr. Henning's contribution to the discussion on gearing, in which he described a method of casting superior gears in baked molds. We have received a copy of Mr. Henning's remarks from the secretary of the society, and reproduce them below.—Ed.]

I think a word ought to be said in favor of cast gears, if they are made in the proper manner. As cast gears are generally made when hot metal is poured in, the result is anything or nothing—cracked gear or anything else. The strength of such gears cannot be determined except accidentally. But there is a way of making cast gears so that they will be nearly as good as the best cut gears, and it is a very simple way. Take a cut pattern and mold it up in a material that will bake pretty hard; then leave the gear right in the mold, and put the whole flask and pattern in the core oven and bake it. The result will be that, as clay or sand expands less than metal, the expanding metal pattern will crowd the sand so that upon cooling, the pattern will lie loose in the mold, and it can be taken right out. The cope is then put on, and before the flask is cold the metal is poured into the flask, which is free from dirt or dust. The dust can be blown out with a blower if it is necessary, but there really is not sufficient dust in the flask to hurt the casting. The metal is put into the hot flask, and the result will be gear which is sufficiently good to run in a printing press without any noise. These gears are used on printing presses, and people who use them do not know that they are not cut gears, because if the cut gear used as a pattern has the slightest tool mark on it those tool marks will appear in the casting. Such gears are used at the present time. I think the patent on this method expired long ago. Such gears are strong. As the mold is hot when the metal is poured in, the shrinking or cooling strains are less, and the metal is not chilled so rapidly when it reaches the mold. It is, of course, chilled, but not so fast; and, besides, the hot flask, with all the material in it, helps to anneal the iron during the cooling process, so that an almost uniform condition of metal is obtained in the gear. In ordinary cast gears there may be anything but a true gear. There are shrinking and cooling strains, possibly a bad core, slight cracks in the corners, even though they are not true shrinkage cracks; there are surface shrinkage cracks which are, I think, generally disregarded, but they are of importance in considering the strength of a gear. Some loose material will perhaps get in the surface of the gear, and as soon as the metal begins to wear down it will wear badly. There are other reasons why an ordinary cast gear is never as strong as the formula indicates; and all formulæ, except when applied to cut gear or annealed gear, should be empirical rather than rational, for the reason that the factor of uncertainty cannot be readily applied to a mathematical—a rational—formula any easier than determining a few strengths of different gear empirically, and then using a formula constructed on those results as a basis. But the method which I have described will give satisfactory results, and can be used for large and small gears with equal facility. These gear patterns require no taper, because the metal expands very much more than the surrounding material, and they can easily be lifted out without any trouble whatever, and the material surrounding the pattern being baked hard, of course, has considerable strength, especially when the material has been saturated with some baking material or substance. There will be no difficulty whatever in doing that, and a gear will be obtained which is equally strong in all parts and one which operates with uniformity. Anyone who has seen printing presses run knows how perfect these gears must be in order to run smoothly for long periods of time without the slightest interruption.

I know of gears 48 inches in diameter having been cast that way, which ran perfectly, and the pitch line did not change, because when the material begins to cool down sufficiently to be a solid mass the clay or sand begins to cool off with it and the two go together. In the first place, the pitch diameter was changed by the expansion of the gear in the mold; but originally that clay was tight to the wheel, and, on the other hand, the molten metal coming in will shrink a little more than the mold will afterwards, so practically they are the same thing. The gears cannot be heard when running, any more than cut gears. If that is true, the gears must certainly be run together so nicely that the variation of pitch diameter is immaterial. They can be seen running on all of the new presses of the Walter Scott Company, in Plainfield, N. J. They are putting them on all presses now, since about two years, and no one knows that he is using cast gears instead of cut gears, because they give the same satisfaction. They are experimenting now on larger gears.

He does not pay much attention to that [the shape of the flask, in reply to a suggestion that round flasks would be more suitable than square ones], because there is always so much packing material around the pattern. I believe he is guided by the size of his baking oven. If he can get the flask in the oven, he takes a flask of that size.

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Dangerous Electrical Conditions.

The danger peculiar to electrical generating works is the liability to shock, which is often fatal if, by accident, anyone comes into contact with the conductors when charged to a high pressure. The contact need neither be very perfect nor direct; provided two parts of the body are made to touch conducting materials which themselves differ in pressure by 1,000 volts or more, or even by much less if the contact with the flesh is very good, a dangerous and possibly fatal shock will result. The ground, especially if damp, is sufficient for one of the contacts, damp leather boots affording no protection, so that anyone standing on the ground or on metallic or damp wood flooring cannot safely touch a single object charged to a dangerous pressure. If, however, he should be standing upon a dry india-rubber mat, which is an excellent non-conductor, he will come to no harm on touching any number of dangerously charged bodies which are at the same electrical pressure; but if he should simultaneously touch, even through his clothes, two bodies which differ from one another in pressure by about 1,000 volts, the actual amount depending largely on the perfection of the contact, or if, while safely touching highly charged metal, he should touch or pass by hand any conducting article to someone else who is not also insulated, then a fatal shock may follow.—"The Electrician," London.

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The Jackson & Sharp Car Company of Wilmington, Del., has an order for twenty-five cars for the Waterloo Underground Railway, London, England. This is expected to be the forerunner of several similar orders; travelers on the other side exhibiting a growing preference for the American type of cars.

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A Union Pacific locomotive built at the Omaha shops recently ran 955 miles in 24 hours, the final spurt of the run being from North Platte to Omaha, 291 miles in 279 minutes.

Commercial Review.

NEW YORK, Saturday Evening, August 7.

DYNAMOS AND MOTORS.

A contemplation of the electrical machinery market for the past few weeks tends to strengthen the impression that this is a year of returning confidence. Making allowance for the dull season of the same, trade may be pronounced, we think, as in the best position it has occupied for many, many long days in the past. This opinion is derived from the bullish tone assumed by representatives of the larger companies. We do not assert that many big orders are being received just at the present time, or that some of the smaller companies do not confess that they find it very quiet. The situation if expressed in exact figures would probably show a decided improvement over that of a year ago for such companies as the General Electric, the Westinghouse, the Walker, the Crocker-Wheeler, and others, who have good orders, now coming in, on hand, or in prospect.

It is also the experience of some concerns that business appears better, rather than worse, with the advancing season, owing, perhaps, it is said, to a settlement of the tariff. Remarks one authority: "There are a great many small orders just now, and these are what pay the best. The situation is improving in the West and South." Says another: "There appears to be three or four times as much inquiry, this year, as last year."

THE HOME MARKET.

Among the contracts closed within the last one or two months, for this country, may be mentioned that to equip the Great Northern grain elevator, in Buffalo, with 1,000 horse-power, and another elevator in the same city with 600 horse-power of Westinghouse motors, to be run by the current generated at Niagara Falls. In the street railway line is an order received by the General Electric Company for fifty car equipments for a road in Jersey City, N. J.

Among the many lighting dynamos recently contracted for, these may be mentioned: For the Sherry Building, this city, Westinghouse; for the Criminal Court Building, this city, and the store of Abraham & Straus, Brooklyn, Crocker-Wheeler; for the New York Light, Heat and Power Company, and the Hotel Royalton, this city, Walker; for a model tannery in Newark, and for Mr. W. R. Hearst's yacht, the "Buccaneer," Bullock. A contract is to be given out by the Arbuckle Sugar Refining Company, of Brooklyn, which will probably constitute a good one for electrical machinery.

THE EXPORT MARKET.

The Bullock Electric Company are doing some business for British account which may result in considerable. They have sold a motor for use in driving a winch on a dock in Glasgow, Scotland, which, it is said, if successful, is likely to bring orders for about thirty more. There is also an inquiry on hand for ninety motors to be shipped to England for driving printing presses. They mention, too, a sale of a lighting dynamo and engine for Mexico.

It is elsewhere reported that two good sized isolated plants for Glasgow are wanted. It is also stated that a certain company, evidently the Westinghouse, have shipped $90,000 worth of electrical machinery during the last three months to England and Germany, and have sold through their London office a number of small dynamos for the Argentine Republic. The C. & C. Electric Company have been selling a number of combined dynamos and engines through their agent in Yokohama, Japan.

A company has been incorporated at Trenton, N. J., for the purposes of building electric light plants and electric railroads at Caracas, Venezuela. It is called the Caracas Electric Heat & Power Company.

A SOLEMN WARNING TO AVARICIOUS AMERICANS.

Some fragments from the daily press cast light upon the reasons why American manufacturers are meeting success in foreign countries. The "Daily Mail," of London, notes indignation on the part of English manufacturers because the contracts for the traction plant of the London Central Underground Railway, amounting to hundreds of thousands of pounds, were placed in the United States. The secretary of the company states in explanation that electrical experts advised this policy, because the greater use of electrical traction in America has accomplished its perfection to a higher degree and reduced its expense. Evidently he refers to the expense of operation, perhaps also to initial cost.

It may have been as a forced result of these mutterings of resentment, or it may have been from its own paternal solicitude, that the Parliament of Great Britain has passed a resolution of censure upon the Underground Railway for its unpatriotic course. What a pity that this had not transpired earlier, so that our own Congress could have had the benefit of the suggestion before it passed the tariff bill. It might have substituted therefor a policy of preventing the importation of foreign goods by legislative censure, and of sending around a voluntary subscription list to raise the revenue.

A similar illustration of the growing English alarm and jealousy at American commercial triumphs is found in a question addressed to the Secretary of State for India in the House of Commons, why the East Indian Railway, owned by the Government, had purchased 7,708 tons of rails from the Maryland Steel Company. He replied that it was because the lowest British bid was £6,875 higher than the American. This represented a difference of about $4.33 a ton and shows that in some respects, at least, we have secured an unmistakeable price advantage. So does a Philadelphia report, which states that the Baldwin Locomotive Works have taken an order for twenty locomotives for Japan. They have already shipped thirty there, of which eighteen were for Government roads. They say that our prices of locomotives are such as to put us practically out of the reach of competition of other nations, English, French or German, but that there is considerable rivalry in Japan and China between the various American companies, resulting in prices even closer than those at home.

FOUNDRY WORK.

T. Shriver & Co., of this city, manufacturers of iron and brass castings, remarked in correspondence with the "American Machinist" a few days since, that they have been making some heavy iron gears; one order, of eight gears, weighing 82,000 pounds. At the time of writing business was yet quiet, but with some signs of improvement.

Quotations.

NEW YORK, Monday, August 9.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$11 50 @ $12 00
No. 2 foundry, Northern	10 00 @ 11 00
No. 2 plain, Northern	10 00 @ 10 50
Gray forge, Northern	9 50 @ 10 00
No. 1 foundry, Southern	10 50 @ 10 75
No. 2 foundry, Southern	10 00 @ 10 25
No. 3 foundry, Southern	9 75 @ 10 00
No. 1 soft, Southern	10 50 @ 10 75
No. 2 soft, Southern	— @ 10 50
Foundry forge, or No. 4, South'n	9 50 @ 9 75

Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.00 @ 1.05c.; refined, 1.10 @ 1.15c. Store prices: Common, 1.25 @ 1.35c.; refined, 1.35 @ 1.45c.

Tool Steel—Ordinary sizes, standard quality, 6 @ 7c., with some grades perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—Ordinary brands, from store, in small lots, 1.45c.

Cold Rolled Steel Shafting—Base size, in small lots, from store, 2.15c.

Copper—Carload lots, Lake Superior ingot, 11⅜ @ 11¼c.; electrolytic, 10⅞ @ 11⅛c.; casting copper, 10⅝ @ 10⅞c.

Pig Lead—Carload lots, 3.75 @ 3.80c., f.o.b.

Pig Tin—For 5 and 10-ton lots, 13.85 @ 13.90c., f. o. b.

Spelter—Carload lots, New York delivery, 4.30 @ 4.35c., f. o. b.

Antimony—The range, according to the several brands and to quantity, is 7 @ 8c.

Lard Oil—Prime city, winter make, commercial quality, in wholesale lots, 36 @ 37c.

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New Catalogs.

There are three sizes of Standard Catalogs, first authorized by the Master Car Builders' Association, 9" x 12", 6" x 9" and 3½" x 6". We recommend the 6" x 9" size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

The New Era Iron Works, of Dayton, O., send us an illustrated catalog of gas and gasoline engines. The catalog is 5½ x 7½ inches.

We have received from the Westinghouse Machine Company, Pittsburg, Pa., a catalog describing the Westinghouse gas engines. The catalog is 6¾ x 9 inches.

Robert Grimshaw, of Dresden, Germany, has sent us catalog "A," printed in the German language, of machine tools, including planers,

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Illustration Department.
A. L. Donnell, Chief.

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Advertising Department.
C. P. Day, Eastern Representative.
J. M. Wakeman, Western Representative.

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English Representative.
R. E. Howard, 9 Leonard St., Finsbury, London, E. C.

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Space in advertising pages only is for sale.

We invite correspondence on subjects pertaining to machinery.

Name and address must always be given, though not necessarily published.

Communications for or relating to the reading columns should be addressed to the Editor. All business communications should be addressed to the Company.

Subscribers can have their mailing address changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.

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SUBSCRIPTION PRICE:

$3.00 a year in advance, postage prepaid in the United States, Canada and Mexico.

$4.00 a year to other countries, postage prepaid.

Entered at Post Office, New York, as second-class mail matter.

For Sale by Newsdealers, Everywhere.

No back numbers beyond 1896.

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Tools with Machines.

Machine tool design is largely a matter of adaptation to the methods and manners of the users of tools, and many an important alteration of design has been made as a result of the discovery that some hitherto unknown genius has, instead of following what the designer considered the obvious method, adopted one of his own for working the tool, which, whether better or worse, had to be provided for in future construction.

This phase of the business is of special importance when machine tools are sent abroad, for it can almost certainly be assumed that a machine tool used outside the United States will not be used in the same manner as it would be at home.

Many an American tool which is entirely successful here fails, or only partially so, and makes necessary to the successful operation of the machine have been developed in the same manner, and machine and tools together form one complete engine, neither portion of which can work as designed to work, except in company with the other. These, of course, are familiar facts, and for that reason it is the more to be wondered at that our builders, in many cases, send bare machines to foreign countries, where the tools and fixtures must be made by men who are absolutely innocent of all the special knowledge and skill necessary to make them properly.

It may be set down as a safe rule of practice, that, even where the tools for a machine seem very simple in character, at least enough of them should accompany every machine to show clearly how they should be made, and it would be all the better if some pains were taken to impress upon the user the fact that the tools sent do not merely happen so, but are the result of experience, and should be altered only after very thorough and careful trial, if at all.

If some of our American builders could see the tools made and used occasionally in foreign shops, they would better appreciate the importance of this point, and would also better understand why their machines in so many cases fail to work abroad as well as at home, or why they are worn out in half the time they are expected to last here.

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Mechanical Pace Makers.

Our columns show continually how completely we believe in the practical helpfulness of intercommunication between those engaged in mechanical pursuits, and how much also we are constantly doing to promote what is in itself, and in its results, so desirable. There are, however, many who will readily acknowledge some of the actual benefits resulting from mutual communicativeness who still fail to appreciate the full scope and influence of it. It is perhaps first in importance that we should each know all that we can of the best and most advanced means and methods of manufacture, so that the best facilities for doing things may be as widely adopted as possible. It

velocity is conceded to be desirable, there is no better way to promote it than by diffusing a knowledge of the general pace, and especially of the rate of every flier. We can have no greater stimulus than may be found in the fact that a rival is just a little faster. The greatest astonishment among our foreign competitors is provoked, not by the ingenuity of our automatic machinery, but by the speed at which it can be, and at which it actually is, operated. We can none of us do our best unless we are crowded, and the closer we are pressed, the better will be our speed. There must be a pace-maker, and neck and neck is very different from six lengths apart.

It is a rather curious fact that this actual knowledge of each other's speed can never work but in the one direction. The struggle is, always to be first and never to be last. The laggard never sets the pace, but merely gets left. The struggle to win stimulates to alertness in securing the means of winning. We have only to know that we must pull faster and that it can be pulled faster, as the other fellow is showing us, to also find the way to do it. Modern methods and modern successes have come more from mutual rivalry in full sight of each contestant than from all else.

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The Secretary of the Navy has taken preliminary steps toward the creation of a Board of Naval Officers to ascertain the cost of a government armor plant and to report to Congress at its next session. Two of the members of the board already selected are Commodore Howell, commandant at League Island, and Captain McCormick, of the Norfolk Navy Yard. The board are not only to ascertain the cost of a modern armor plant, but must also take into account the propriety, or rather the necessity of establishing also in connection with it a complete plant for the production of steel ingots. If it should be held to be absolutely necessary, as is done in the best practice to-day, to follow up the processes upon the ingot without allowing it to cool, the government will be obliged to establish a steel plant alongside the armor plant, and as

British references they refused to consider any. Does this result from differences in shop practices, which may make a machine tool good in one country and bad in another, or is it that we are too careless with our testimonials? Either or both of these causes might operate to produce the observed phenomenon.

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Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

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Length of Ports 4
Travel of Valve 7

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Permanent Exposition of Machinery in Peru.

The Consul General of Peru requests us to publish the following circular:

"The Peruvian Government, wishing to increase trade in the machinery and kindred lines with manufacturing countries, has decided to establish a permanent exposition of all classes of manufactured articles in the lines of machinery, giving preference to such as are mostly used in Peru, viz., agricultural implements, mining machinery, electrical appliances of every description and apparatus for labor-saving machinery.

"The Peruvian Government have never before given such inducements to foster

trade, and the facilities offered to American manufacturers are advantageous.

"All exhibits will be exempt from Custom House duties as well as from Consular fees. The Exposition will be inaugurated in December 9th next, at Lima, Peru.

"Exhibitors will have the option to show their wares for a period of six months, should longer time be required, arrangements may be made by applying to the officials in charge.

"Further particulars and copy of the rules and regulations with application blank will be cheerfully furnished by

"CARLOS G. ESTENOS,
"Acting Consul General."

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Casting Gears in Baked Molds.

BY GUS C. HENNING.

[In our report of the Hartford meeting of the American Society of Mechanical Engineers, mention was made of Mr. Henning's contribution to the discussion on gearing, in which he described a method of casting superior gears in baked molds. We have received a copy of Mr. Henning's remarks from the secretary of the society, and reproduce them below.—Ed.]

I think a word ought to be said in favor of cast gears, if they are made in the proper manner. As cast gears are generally made when hot metal is poured in, the result is anything or nothing—cracked gear or anything else. The strength of such gears cannot be determined except accidentally. But there is a way of making cast gears so that they will be nearly as good as the best cut gears, and it is a very simple way. Take a cut pattern and mold it up in a material that will bake pretty hard; then leave the gear right in the mold, and put the whole flask and pattern in the core oven and bake it. The result will be that, as clay or sand expands less than metal, the expanding metal pattern will crowd the sand so that upon cooling, the pattern will lie loose in the mold, and it can be taken right out. The cope is then put on, and before the flask is cold the metal is poured into the flask, which is free from dirt or dust. The dust can be blown out with a blower if it is necessary, but there really is not sufficient dust in the flask to hurt the casting. The metal is put into the hot flask, and the result will be gear which is sufficiently good to run in a printing press without any noise. These gears are used on printing presses, and people who use them do not know that they are not cut gears, because if the cut gear used as a pattern has the slightest tool mark on it those tool marks will appear in the casting. Such gears are used at the present time. I think the patent on this method expired long ago. Such gears are strong. As the mold is hot when the metal is poured in, the shrinking or cooling strains are less, and the metal is not chilled so rapidly when it reaches the mold. It is, of course, chilled, but not so fast; and, besides, the hot flask, with all the material in it, helps to anneal the iron during the cooling process, so that an almost uniform condition of metal is obtained in the gear. In ordinary cast gears there may be anything but a true gear. There are shrinking and cooling strains, possibly a bad core, slight cracks in the corners, even though they are not true shrinkage cracks; there are surface shrinkage cracks which are, I think, generally disregarded, but they are of importance in considering the strength of a gear. Some loose material will perhaps get in the surface of the gear, and as soon as the metal begins to wear down it will wear badly. There are other reasons why an ordinary cast gear is never as strong as the formula indicates; and all formulæ, except when applied to cut gear or annealed gear, should be empirical rather than rational, for the reason that the factor of uncertainty cannot be readily applied to a mathematical—a rational—formula any easier than determining a few strengths of different gear empirically, and then using a formula constructed on those results as a basis. But the method which I have described will give satisfactory results, and can be used for large and small gears with equal facility. These gear patterns require no taper, because the metal expands very much more than the surrounding material, and they can easily be lifted out without any trouble whatever, and the material surrounding the pattern being baked hard, of course, has considerable strength, especially when the material has been saturated with some baking material or substance. There will be no difficulty whatever in doing that, and a gear will be obtained which is equally strong in all parts and one which operates with uniformity. Anyone who has seen printing presses run knows how perfect these gears must be in order to run smoothly for long periods of time without the slightest interruption.

I know of gears 48 inches in diameter having been cast that way, which ran perfectly, and the pitch line did not change, because when the material begins to cool down sufficiently to be a solid mass the clay or sand begins to cool off with it and the two go together. In the first place, the pitch diameter was changed by the expansion of the gear in the mold; but originally that clay was tight to the wheel, and, on the other hand, the molten metal coming in will shrink a little more than the mold will afterwards, so practically they are the same thing. The gears cannot be heard when running, any more than cut gears. If that is true, the gears must certainly be run together so nicely that the variation of pitch diameter is immaterial. They can be seen running on all of the new presses of the Walter Scott Company, in Plainfield, N. J. They are putting them on all presses now, since about two years, and no one knows that he is using cast gears instead of cut gears, because they give the same satisfaction. They are experimenting now on larger gears.

He does not pay much attention to that [the shape of the flask, in reply to a suggestion that round flasks would be more suitable than square ones], because there is always so much packing material around the pattern. I believe he is guided by the size of his baking oven. If he can get the flask in the oven, he takes a flask of that size.

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Dangerous Electrical Conditions.

The danger peculiar to electrical generating works is the liability to shock, which is often fatal if, by accident, anyone comes into contact with the conductors when charged to a high pressure. The contact need neither be very perfect nor direct; provided two parts of the body are made to touch conducting materials which themselves differ in pressure by 1,000 volts or more, or even by much less if the contact with the flesh is very good, a dangerous and possibly fatal shock will result. The ground, especially if damp, is sufficient for one of the contacts, damp leather boots affording no protection, so that anyone standing on the ground or on metallic or damp wood flooring cannot safely touch a single object charged to a dangerous pressure. If, however, he should be standing upon a dry india-rubber mat, which is an excellent non-conductor, he will come to no harm on touching any number of dangerously charged bodies which are at the same electrical pressure; but if he should simultaneously touch, even through his clothes, two bodies which differ from one another in pressure by about 1,000 volts, the actual amount depending largely on the perfection of the contact, or if, while safely touching highly charged metal, he should touch or pass by hand any conducting article to someone else who is not also insulated, then a fatal shock may follow.—"The Electrician," London.

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The Jackson & Sharp Car Company of Wilmington, Del., has an order for twenty-five cars for the Waterloo Underground Railway, London, England. This is expected to be the forerunner of several similar orders; travelers on the other side exhibiting a growing preference for the American type of cars.

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A Union Pacific locomotive built at the Omaha shops recently ran 955 miles in 24 hours, the final spurt of the run being from North Platte to Omaha, 291 miles in 270 minutes.

Commercial Review.

NEW YORK, Saturday Evening, August 7.

DYNAMOS AND MOTORS.

A contemplation of the electrical machinery market for the past few weeks tends to strengthen the impression that this is a year of returning confidence. Making allowance for the dull season of the same, trade may be pronounced, we think, as in the best position it has occupied for many, many long days in the past. This opinion is derived from the bullish tone assumed by representatives of the larger companies. We do not assert that many big orders are being received just at the present time, or that some of the smaller companies do not confess that they find it very quiet. The situation if expressed in exact figures would probably show a decided improvement over that of a year ago for such companies as the General Electric, the Westinghouse, the Walker, the Crocker-Wheeler, and others, who have good orders, now coming in, on hand, or in prospect.

It is also the experience of some concerns that business appears better, rather than worse, with the advancing season, owing, perhaps, it is said, to a settlement of the tariff. Remarks one authority: "There are a great many small orders just now, and these are what pay the best. The situation is improving in the West and South." Says another: "There appears to be three or four times as much inquiry, this year, as last year."

THE HOME MARKET.

Among the contracts closed within the last one or two months, for this country, may be mentioned that to equip the Great Northern grain elevator, in Buffalo, with 1,000 horse-power, and another elevator in the same city with 600 horse-power of Westinghouse motors, to be run by the current generated at Niagara Falls. In the street railway line is an order received by the General Electric Company for fifty car equipments for a road in Jersey City, N. J.

Among the many lighting dynamos recently contracted for, these may be mentioned: For the Sherry Building, this city, Westinghouse; for the Criminal Court Building, this city, and the store of Abraham & Straus, Brooklyn, Crocker-Wheeler; for the New York Light, Heat and Power Company, and the Hotel Royalton, this city, Walker; for a model tannery in Newark, and for Mr. W. R. Hearst's yacht, the "Buccaneer," Bullock. A contract is to be given out by the Arbuckle Sugar Refining Company, of Brooklyn, which will probably constitute a good one for electrical machinery.

THE EXPORT MARKET.

The Bullock Electric Company are doing some business for British account which may result in considerable. They have sold a motor for use in driving a winch on a dock in Glasgow, Scotland, which, it is said, if successful, is likely to bring orders for about thirty more. There is also an inquiry on hand for ninety motors to be shipped to England for driving printing presses. They mention, too, a sale of a lighting dynamo and engine for Mexico.

It is elsewhere reported that two good sized isolated plants for Glasgow are wanted. It is also stated that a certain company, evidently the Westinghouse, have shipped $90,000 worth of electrical machinery during the last three months to England and Germany, and have sold through their London office a number of small dynamos for the Argentine Republic. The C. & C. Electric Company have been selling a number of combined dynamos and engines through their agent in Yokohama, Japan.

A company has been incorporated at Trenton, N. J., for the purposes of building electric light plants and electric railroads at Caracas, Venezuela. It is called the Caracas Electric Heat & Power Company.

A SOLEMN WARNING TO AVARICIOUS AMERICANS.

Some fragments from the daily press cast light upon the reasons why American manufacturers are meeting success in foreign countries. The "Daily Mail," of London, notes indignation on the part of English manufacturers because the contracts for the traction plant of the London Central Underground Railway, amounting to hundreds of thousands of pounds, were placed in the United States. The secretary of the company states in explanation that electrical experts advised this policy, because the greater use of electrical traction in America has accomplished its perfection to a higher degree and reduced its expense. Evidently he refers to the expense of operation, perhaps also to initial cost.

It may have been as a forced result of these mutterings of resentment, or it may have been from its own paternal solicitude, that the Parliament of Great Britain has passed a resolution of censure upon the Underground Railway for its unpatriotic course. What a pity that this had not transpired earlier, so that our own Congress could have had the benefit of the suggestion before it passed the tariff bill. It might have substituted therefor a policy of preventing the importation of foreign goods by legislative censure, and of sending around a voluntary subscription list to raise the revenue.

A similar illustration of the growing English alarm and jealousy at American commercial triumphs is found in a question addressed to the Secretary of State for India in the House of Commons, why the East Indian Railway, owned by the Government, had purchased 7,708 tons of rails from the Maryland Steel Company. He replied that it was because the lowest British bid was £6,875 higher than the American. This represented a difference of about $4.33 a ton and shows that in some respects, at least, we have secured an unmistakeable price advantage. So does a Philadelphia report, which states that the Baldwin Locomotive Works have taken an order for twenty locomotives for Japan. They have already shipped thirty there, of which eighteen were for Government roads. They say that our prices of locomotives are such as to put us practically out of the reach of competition of other nations, English, French or German, but that there is considerable rivalry in Japan and China between the various American companies, resulting in prices even closer than those at home.

FOUNDRY WORK.

T. Shriver & Co., of this city, manufacturers of iron and brass castings, remarked in correspondence with the "American Machinist" a few days since, that they have been making some heavy iron gears; one order, of eight gears, weighing 82,000 pounds. At the time of writing business was yet quiet, but with some signs of improvement.

Quotations.

NEW YORK, Monday, August 9.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$11 50 @ 12 00
No. 2 foundry, Northern	10 00 @ 11 00
No. 2 plain, Northern	10 00 @ 10 50
Gray forge, Northern	9 50 @ 10 00
No. 1 foundry, Southern	10 50 @ 10 75
No. 2 foundry, Southern	10 00 @ 10 25
No. 3 foundry, Southern	9 75 @ 10 00
No. 1 soft, Southern	10 50 @ 10 75
No. 2 soft, Southern	— @ 10 50
Foundry forge, or No. 4, South'n	9 50 @ 9 75

Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.00 @ 1.05c.; refined, 1.10 @ 1.15c. Store prices: Common, 1.25 @ 1.35c.; refined, 1.35 @ 1.45c.

Tool Steel—Ordinary sizes, standard quality, 6 @ 7c., with some grades perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—Ordinary brands, from store, in small lots, 1.45c.

Cold Rolled Steel Shafting—Base size, in small lots, from store, 2.15c.

Copper—Carload lots, Lake Superior ingot, 11⅛ @ 11¼c.; electrolytic, 10⅞ @ 11⅛c.; casting copper, 10⅝ @ 10⅞c.

Pig Lead—Carload lots, 3.75 @ 3.80c., f. o. b.

Pig Tin—For 5 and 10-ton lots, 13.85 @ 13.90c., f. o. b.

Spelter—Carload lots, New York delivery, 4.30 @ 4.35c., f. o. b.

Antimony—The range, according to the several brands and to quantity, is 7 @ 8c.

Lard Oil—Prime city, winter make, commercial quality, in wholesale lots, 36 @ 37c.

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New Catalogs.

There are three sizes of Standard Catalogs, first authorized by the Master Car Builders' Association, 9" x 12", 6" x 9" and 3½" x 6". We recommend the 6" x 9" size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

The New Era Iron Works, of Dayton, O., send us an illustrated catalog of gas and gasoline engines. The catalog is 5½ x 7½ inches.

We have received from the Westinghouse Machine Company, Pittsburg, Pa., a catalog describing the Westinghouse gas engines. The catalog is 6¾ x 9 inches.

Robert Grimshaw, of Dresden, Germany, has sent us catalog "A," printed in the German language, of machine tools, including planers,

lathes, milling machines, etc. The catalog is 5½ x 8½ inches.

The Garvin Machine Company, of New York, send us a book showing interior views of their plant. The book contains about forty different half-tone illustrations, and is standard size, 6 x 9 inches.

The Hugh Hill Tool Company, Anderson, Ind., sends us a catalog illustrating and describing the "Hugh Hill" tool holders, for use on turning, planing and boring metals. The catalog is 3¼ x 6 inches.

The George Burnham Company, of Worcester, Mass., have sent us an illustrated catalog and price list of upright drills, bench drills, drill chucks, etc. The catalog is small standard size, being 3½ x 6 inches.

We have received from the Bullock Electric Manufacturing Company, Cincinnati, O., bulletins Nos. 25 and 27. These bulletins are issued from time to time, showing the special applications of this company's apparatus.

We have received from Hardinge Bros., Chicago, Ill., catalog describing and illustrating various styles of screw chucks, burnishers, grinders, polishing attachments and other jewelers' tools. The catalog is 6 x 6¾ inches.

We have received from George B. Grant, Boston, Mass., a catalog and price list of various kinds of gears. The catalog contains some valuable information to those interested in the subject of gears and gearing, and is 5½ x 8½ inches.

We have received from the Weber Gas & Gasoline Engine Company, Kansas City, Mo., a catalog in which are described and illustrated gasoline hoisting engines, adapted for mining, quarry and wharf use. The catalog is 6 x 9½ inches.

Fairbanks, Morse & Co., Chicago, Ill., send us a catalog of pumping machinery, including mine and fire pumps. The catalog contains some interesting formulæ for calculations in connection with pumping machinery, and is standard size, 6 x 9 inches.

We have received from the Murphy Iron Works, Detroit, Mich., a catalog in which is illustrated and described the Murphy automatic smokeless furnace. The catalog contains a list of firms which use these furnaces, and is standard size, 6 x 9 inches.

We have received from the Mead Cycle Company, Chicago, Ill., a catalog devoted to the description and illustration of "Sentinel" ladies' and gentlemen's wheel. A description of the various parts of this wheel is given, and also of the "Kenmore." The catalog is 5¾ x 7¾ inches.

We have received from Newton Machine Tool Works, Incorporated, Philadelphia, catalog No. 33, which is devoted to the description and illustration of various kinds of machinery used in machine-shop equipment, including planers, milling machines, drilling machines, boring machines and many others. The catalog contains 180 pages, and is standard size, 6 x 9 inches.

We are in receipt, from the Mossberg & Granville Manufacturing Company, Providence, R. I., a catalog of presses, roller bearings, shears, drills and various other styles of machines used in the working of metals. The catalog contains 220 standard size 6 x 9 inch pages, and a copy will be mailed to those interested in the purchase of drop presses, wire drawing machinery, rolling mills, etc.

We have received the 1897 copy of the Brown & Sharpe Manufacturing Company's catalog, which is the first in which the distinction between the Brown & Sharpe Manufacturing Company and Darling, Brown & Sharpe is done away with, and the absorption of the last-named firm by the first is announced. This gives additional convenience

(*Continued on page 37.*)

Business Specials.

Gear wheels, gear cutting. Grant; see page 16.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Mch. shop equipments. York & Co., Cleveland, O.

Engine Castings ⅛ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Gear and milling cutters, adjust. reamers, counterbars and tools, vert. millers, drill pr., cutter and surf. grind., shears. R. M. Clough, New Haven, Ct.

Cost of Manufacturing—Experienced manager will establish system of costs, giving exact account of every detail. Charge based on saving effected. Correspondence solicited. Geo. C. Thomas, 99 Nassau Street, New York, Room 212.

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Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday Morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

Tools, dies, light mach., exp. Box 138, Am. Mach.

Prac. toolmkr. & dftmen wants wk. 124, Am. Mach.

Exp. mch. draftsman. Box 100, Am. Machinist.

Wanted—Change by reliable all-round mech.; 28, 12 yrs. exp., ptns., mdls. and expmtl. 123, Am. Mach.

Experienced all-round mech. draftsman desires position; moderate salary. Box 121, Amer. Mach.

A mech. eng., grad., with 18 months' exp., desires position; salary moderate. Box 117, Am. Machinist.

Foreman pattern maker wants situation; A1 references; salary moderate. Box 143, Am. Mach.

Experienced mechanical draftsman seeks pos.; 14 years exp. shop and office. Box 142, Am. Machinist.

Wanted sit. as foreman of foundry, had 20 years experience, can give best ref. Box 128, Am. Mach.

Experienced d'ftsman and designer on hydraulic and gen. mach. open for eng'ment. 127, Am. Mach.

Toolmaker, experienced on jig fixtures and fine special mach.; handled help. Box 139, Am. Mach.

A mechanical engineer holding position of chief engineer in a large steam plant, wishes to change posi. for very good reasons. Box 134, Am. Mach.

Mech. draftsman, tech. grad., 6 years exp. wants a posi. Steam engines, coal and ore handling mach. Competent to take charge of office. 129, Am. Mach.

Exp. and successful shop manager wishes to make a change; superintendent or foreman position desired; best of references. Box 316, Providence, R. I.

Wanted—Situation by experienced man; has held pos. as toolmaker, foreman and assistant supt.; up on modern methods; ref. Box 130, Am. Machinist.

Young man, grad. M. E., some shop exp., supt. 4 yrs. dur'g develop. and mfr. of smokeless powder, desires posi., preferably in experimental and testing dept. Box 137, American Machinist.

An expert tool maker with tech. educ., familiar with engine and elevator work and with several years exp. on stamping mach., registers, etc., wants western position. Box 136, American Machinist.

Sit. Wanted—Screw tool mkr. 25 yrs. exp., 9 yrs. of that time cont. in one of largest gun and bicycle fact. in U. S. Ball bearings and all work on bicycle made on screw mach. a specialty 133, Am. Mach.

First-class patternmaker desires position in charge; extensive practical experience in large green sand and loam work. Salary moderate at start. Good draftsman. Box 131, Amer. Machinist.

Experienced foreman and designer, hustler, up-to date, 15 years exp. general machinery, wants change; long illness of principal owner; firm to close; references. Address Box 140, Amer. Mach.

Help Wanted.

Wanted—A man who thoroughly understands hardening jewelers' rolls. Address, stating experience and wages wanted, Box 130, Am. Machinist.

Wanted—Inspector for large machine shop. Must be thoroughly familiar with drawings and a first-class mechanic. One who has held a similar position given preference. Steady job to right man. Good wages. Ref. required. Box 135, Am. Mach.

Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S. M. York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Patents, Machinery Designed, Drawings. Henry F. Noyes, 56 Liberty Street, New York.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

Wanted—Well equipped boiler shop to manufacture A No. 1 safety water tube boiler. Address particulars, "Engineer," American Machinist.

Model Locomotives—Complete castings, latest N. Y. Cen. standard, up to date; 4c. in stamps for cat. alog. G. H. Olney, 163 Herkimer St., Brooklyn, N.Y.

Lathes, planers, drills, milling machines, vises, also brass working machinery second-hand; must be modern, cheap and in first-class condition. C. C. Wormer Machinery Co., Detroit, Mich.

English agent, with extensive connection among buyers of Amer. mchy., wishes to solely represent a first-class firm Am. mch. tool makers. "Tools," care Parkinson, 20 Sackville St., Manchester, Eng.

Wanted Capital, $10,000—A one-half interest in an established machine tool company is offered a practical man having the executive ability to conduct the business. Strictly modern shop and equipment with ample orders. Address Box 49, American Machinist.

A machine shop, with modern equipment, heavy and light machinery, cranes of 20 tons capacity and 10,000 square feet of unoccupied floor space, would contract to manufacture any kind of machinery. Parties already having machinery built under contract might do well to write us for estimates. Box 62, American Machinist.

One of the first machine tool factories of Germany wants the agency of a first-class American tool factory for Germany or the whole Continent. This factory sustains the best of relations to all the leading industrial works in Germany, as well as abroad, and can bid fair prospects of good business. Address Box 132, American Machinist.

An experienced pulp and paper mach'y designer owns designs of simplest and most durable screen on market, especially for fine sulphite work. Has built 8 in small shop that are now working sulphite in plates 10/,000 fine; complete success. Owner wishes to engage with modern firm who would build and push same. Testimonials from users. Address Box 141, American Machinist.

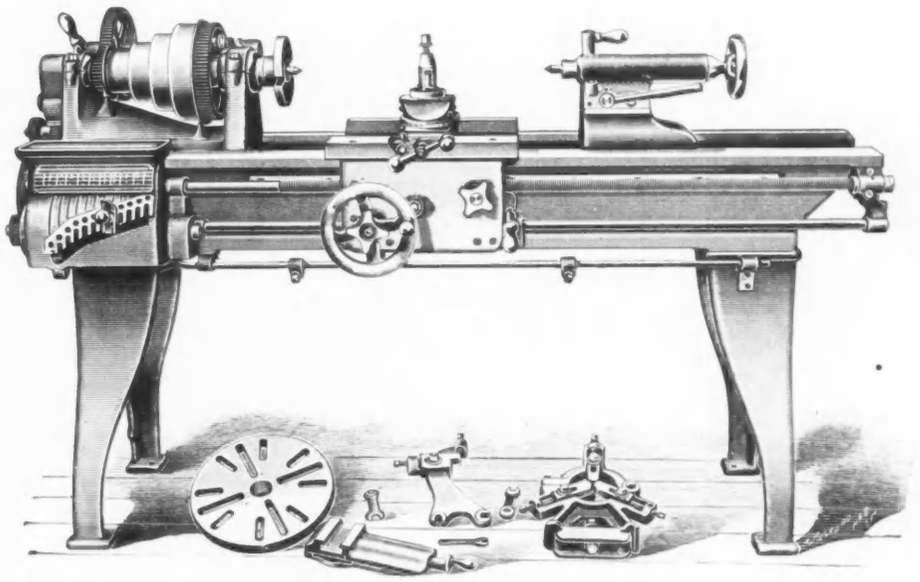
If you are in need of a
FIRST-CLASS
Milling Machine
Write to the
Brainard Milling Machine Co.
Factory, Hyde Park, Mass.
Offices with Hill, Clarke & Co., Boston and Chicago.

FOR ADVERTISEMENT OF
Morse, Williams & Co. Philadelphia, Pa.
See Issue of Aug. 5, 1897.

MICHIGAN COLLEGE OF MINES.
A State technical school. Practical work. Special facilities for men of age and experience. Elective system. 45 weeks a year. Non-resident tuition $150 a year. For Catalogues, address
Dr. M. E. Wadsworth, President, Houghton, Mich.

MODEL WORK.
We are prepared to assist the trade and inventors in solving mechanical problems, also manufacturing models and stock
CENTURY MACHINE CO.
576 West Broadway, New York.
Complete outfit of Modern Machinery and Tools.

THIS LATHE COMBINES THE LATEST AND BEST IMPROVEMENTS.



14 in. x 6 ft. Hendey-Norton Lathe

With Improved Automatic Stop.

• • •

AUTOMATIC STOP

It is durable, simple, indispensable. It will automatically stop the carriage in either direction. It is equally efficient whether feeding or thread-cutting, running up to a shoulder, boring to bottom of holes, or internal thread-cutting. No danger of spoiling either tool or work. It is a safeguard against accidents in either direction.

CARRIAGE

The carriage reverses in apron; no slamming of countershaft. There is no comparison between this lathe and the old style or common lathe.

THREADS

It has all threads in daily use with simple movement of lever.

FEEDS

Has all feeds in daily use with simple movement of lever. Send for Circular.

• • •

THE HENDEY MACHINE COMPANY,

Torrington, Conn.

Agents for the Pacific Coast, PACIFIC TOOL AND SUPPLY CO., San Francisco, Cal.

European Agents { CHAS. CHURCHILL & CO., Ltd., London and Birmingham. SCHUCHARDT & SCHÜTTE, Berlin and Vienna. EUGENE SOLLER, Basel Switzerland.

(Continued from page 30.)

to a catalog which has for years been of great use to mechanics and engineers, and it is sent free to any address.

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Manufactures.

At Lincoln, Neb., Mr. Dunn is to erect a new hemp mill.

At Canton, Pa., Bunn Bros., of Union, are to erect a new mill.

At Englewood, Fla., Heacock Bros. are enlarging their mill.

At Belle Center, O., A. B. Wylie is building an addition to his mill.

Foster & Yore propose to erect a stamp mill near Fort Jones, Cal.

The Lamb Wire Fence Company are to erect a new factory at Adrian, Mich.

At Dexter, Me., Amos Abbott & Co. are to erect an addition to their plant.

Rawson Bros., of Cincinnati, O., have decided to erect a factory building.

It is expected that at Shideler, Ind., will be located an iron and brass foundry.

The Pratt Chuck Company contemplate locating their plant at Frankfort, N. Y.

At Coatesville, Pa., a brick addition is being made to the iron works of Worth Bros.

At Columbus, O., the foundry of Charles Schenck was recently destroyed by fire.

At Castalia, O., the Castalia Portland Cement Company will erect new buildings.

At Krumville, N. Y., Stephen Davis contemplates building a mill in the near future.

It is expected that the Northern Central shops at Elmira, N. Y., will be enlarged.

At Mount Carmel, Pa., the Anthracite Brewing Company are to erect a new building.

At Nelson, B. C., the Fern Mine Company contemplate the erection of a new stamp mill.

The Boyd & Corey Shoe Company, of Augusta, Me., are to erect a factory 182 x 42 feet.

At Woonsocket, R. I., the Woonsocket Napping Machine Company are erecting a new shop.

The La Belle Iron Company, Wheeling, W. Va., contemplate the erection of a new tin-plate mill.

The Ajax Milling Company, at Garfield, Wash., will remodel their mill and increase its capacity.

An addition is being erected to the plant of the Whitney Machine Works Company at New Orleans, La.

At Philadelphia, the Northern Electric Light & Power Company are to make an addition to their plant.

The Charles Scott Spring Company, of Philadelphia, Pa., are to erect an additional four-story building.

The plant of the Pittsburg Foundry & Machine Company, Pittsburg, Pa., has been destroyed by fire.

The Thomas Brass & Iron Company, of Waukegan, Ill., contemplate the enlargement of their plant.

At Ottawa, Ill., the Plant of the Pioneer Fire-Proof Construction Company has been destroyed by fire.

The plant of the Badger Paper Company at Kaukauna, Wis., has been completely destroyed by fire.

The Ideal Stove & Foundry Works, Daleville, Ind., are building a plant for the manufacture of stoves.

The South Carolina & Georgia Railroad Company are intending to erect an elevator at Charleston, S. C.

At Little Rock, Ark., the George Taylor

Commission Company contemplate the erection of a compress.

Plans have been filed for a six-story factory at John and Willow streets, Philadelphia, Pa., for Charles Bockius.

The Sioux City (Ia.) Starch Works have proved too small, and an enlargement of the plant is contemplated.

The molding and machine shops of the Ersham Machine Company, at Enterprise, Kan., have been burned.

The National Safety Match Company, of Chicago, is contemplating the erection of a factory in Baltimore, Md.

At Port Oram, N. J., the concentrating plant of the New Jersey Iron Mining Company was recently destroyed by fire.

Mr. Joel Reish, of Lewisburg, Pa., has purchased the distillery property in Buffalo Township, and will rebuild.

At Masillon, O., W. H. Shoupe, of Fostoria, O., has purchased the American Steam Laundry, and will add new machinery.

The American Construction Company, of San Francisco, Cal., has been incorporated by E. C. Burr, J. C. Steel and others.

The Somerset Chemical Company are to erect at Bound Brook, N. J., a new plant. There will be ten separate buildings.

It is expected that very soon a new shoe factory will be erected at Brocton, Mass. G. E. Keith Shoe Company are interested.

The Tyler Foundry & Machine Company was recently incorporated at Tyler, Tex., to engage in the general foundry business.

At South Omaha, Neb., it is expected the Chicago Nutriment Company will erect a factory, if a suitable site can be secured.

The Jeanesville Iron Works Company, of Jeanesville, Pa., has been incorporated by J. C. Hayden, T. M. Morris, Samuel Garner, etc.

Lewis & Allen, Jackson, Mich., proprietors of the vehicle spring works, are to erect a new building, to be used as an axle factory.

Mr. E. J. Kruce, Lansing, Mich., expects to move to Detroit, same State, and has let the contract for the erection of a factory at that city.

At Boyertown, Pa., the Franklin Improvement Company will erect a hosiery mill, to be ready for occupancy about the middle of October.

The Findlay Glycerine Company has just been organized at Findlay, O., and has commenced work on the construction of a new factory.

The George B. Sennet Company has been organized at Youngstown, Pa., to manufacture heavy machinery. The capital stock is $100,000.

The Mercur West Dip Gold Mining Company, of Salt Lake City, has been incorporated. Arthur Murphy is president and B. T. Lloyd is secretary.

At Salt Lake City, Utah, the Bingham Lead & Silver Mining Company has been organized. M. M. Freed is president and C. M. Freed vice-president.

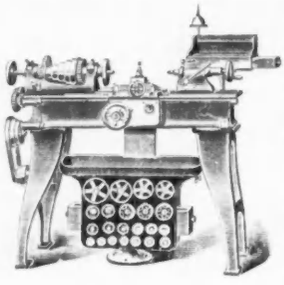
Mr. H. M. Underwood is contemplating the erection of a factory at La Crosse, Wis. When in running condition about 300 men will be employed.

A new power-house is to be erected on Ninety-fifth and Ninety-sixth streets, New York City, for the Metropolitan Street Railway Company.

The George A. Schmidt Company, of Chicago, Ill., has been incorporated. Incorporators: Julian W. Mack, Phillip Clarkson and Eugene Hildebrand.

At Minneapolis, Minn., J. W. Hernlund,

(Continued on page 39)



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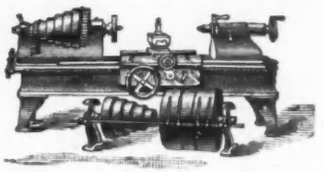

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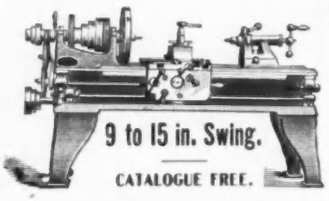

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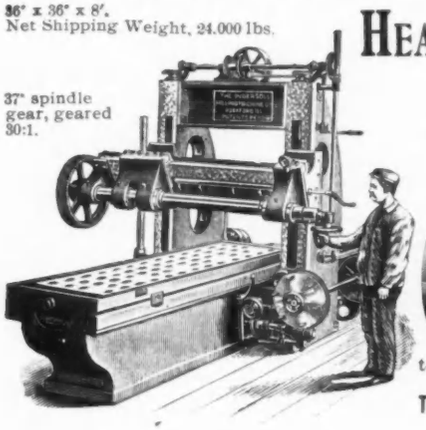

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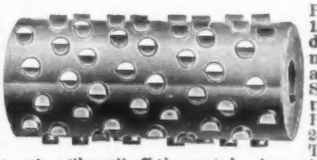

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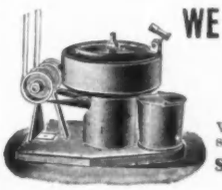

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(Continued from page 38.)

who has been for several years with the Crown Iron Works, contemplates the erection of a new iron foundry.

At Portland, Me., the Lewis C. Bass Company has been organized for the purpose of manufacturing mill supplies. Lewis C. Bass, of Boston, Mass., is president.

Messrs. Fritz & Krause, owners of the Royersford Mills, will establish a branch mill at Pottstown, Pa. The new mill will be equipped with the most improved knitting machinery.

The Florence Mining Company has been incorporated at Salt Lake City, Utah. Mr. Fred Crowton is president; Fred Hodder, vice-president; J. R. Bowdee, secretary, and John A. Williams, treasurer.

At Denver, Col., the Sauvage Brake Company has been incorporated with a capital of $100,000. The incorporators are W. H. Sauvage, W. H. Bennett, J. E. Brown, E. L. Davis and T. M. Ingersoll.

At Ashtabula, O., the Payne Railroad Switch & Equipment Company has been formed with a capital of $50,000. The incorporators are Stephen R. Payne, H. J. Bailey, A. P. Laughlin and others.

At Kansas City, Kan., George Bemarkt contemplates the erection of a new foundry. The new building will be two stories high and 150 x 54 feet. The plant is to be equipped with the most improved machinery.

At Jackson, Tenn., a new cotton compress is about to be erected. The new compress will be under the direction of Mr. D. P. Bestor, of Mobile, Ala. The new plant will contain the most improved class of machinery.

The Davenport & Tracey Company, of Jersey City, N. J., has been incorporated to engage in the manufacture of brass and iron castings. The incorporators are James F. Fielder and William Brinkerhoff, of Jersey City.

The Becker Milling Machine Company, of New York City, has been incorporated to engage in the manufacture of milling machines and machine tools. Directors: George Becker, Philip Becker and W. J. Thompson, of New York City.

Mr. F. W. Horne, who is now on his way to Yokohama, Japan, has placed an order for lathes, planers, shapers, milling machines, etc., with the Davis & Egan Machine Tool Company, of Cincinnati, O. He will represent that company in China and Japan.

The United Gas Improvement Company, of Philadelphia, are erecting at Atlanta, Ga., a water tower and tank. The tank has a capacity of 10,000 gallons, and is supported on a tower 60 feet high. They have let the contract for furnishing and erecting the tank and tower to the Berlin Iron Bridge Company, of East Berlin, Conn.

The Davis & Egan Machine Tool Company, of Cincinnati, O., have purchased the property formerly occupied by the W. S. Merrill Chemical Company, which adjoins the present works of the first-mentioned company. The newly-acquired building is modern and well adapted to the operation of heavy machinery, has a frontage of 103 feet, is five stories high, and has a railroad frontage on two streets. It is being equipped for use as a power plant.

The Newport News Shipbuilding & Dry Dock Company are making extensive additions to their already large plant at Newport News, Va. One of the additions under way is the erection of an extension to their machine shop, which will be 100 feet wide and 200 feet long. This building will be used for the finishing and erecting of marine engines and other large machinery. The Berlin Iron Bridge Company, of East Berlin, Conn., have the contract for furnishing and erecting the steel work of the building.

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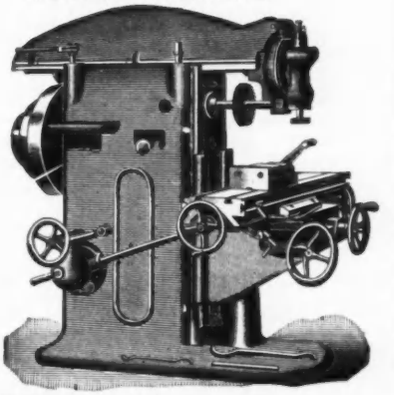

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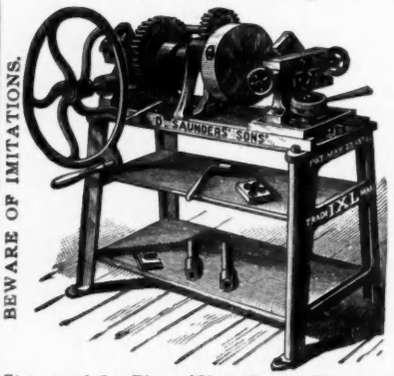

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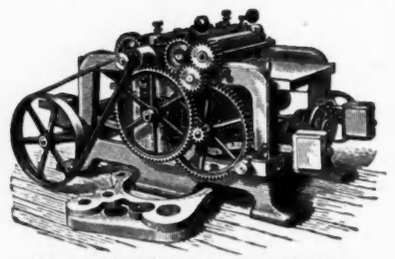

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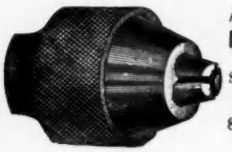

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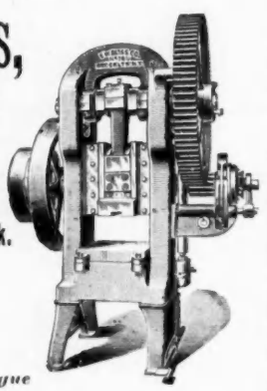

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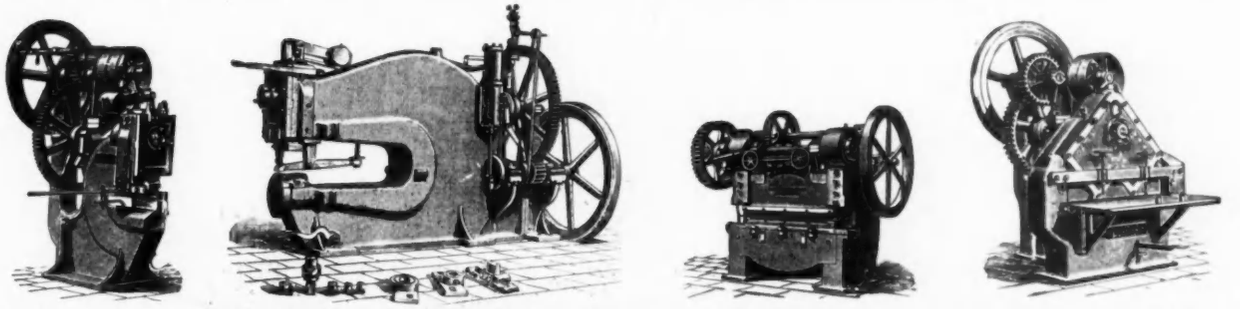

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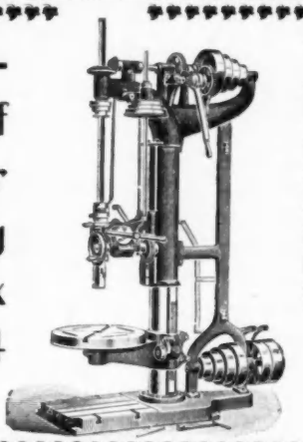

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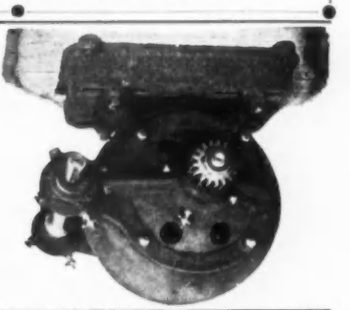

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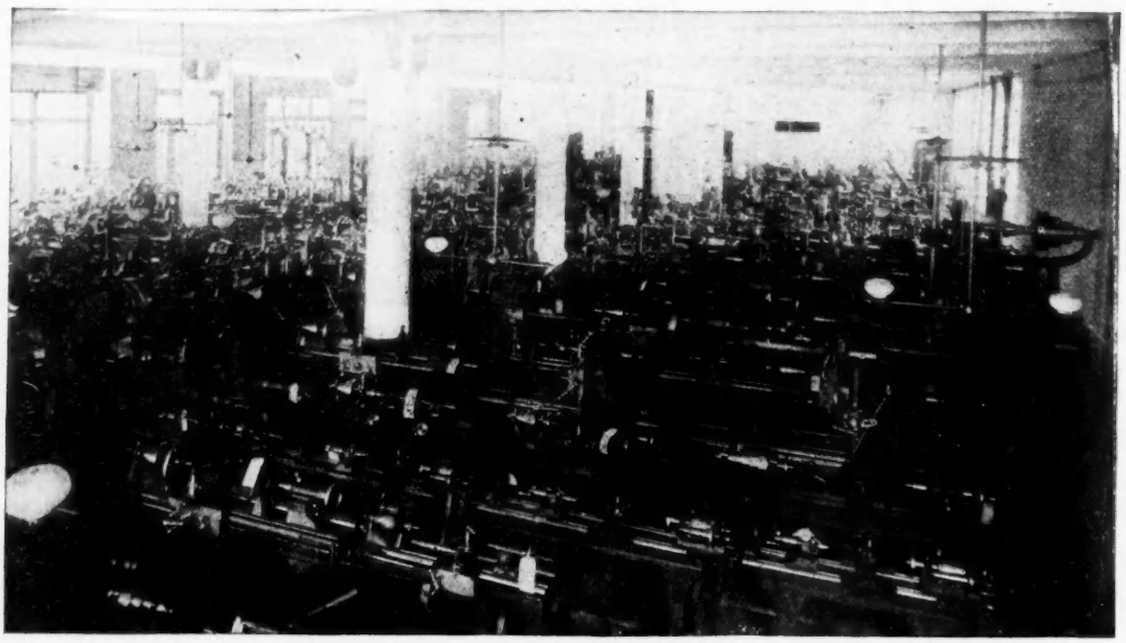

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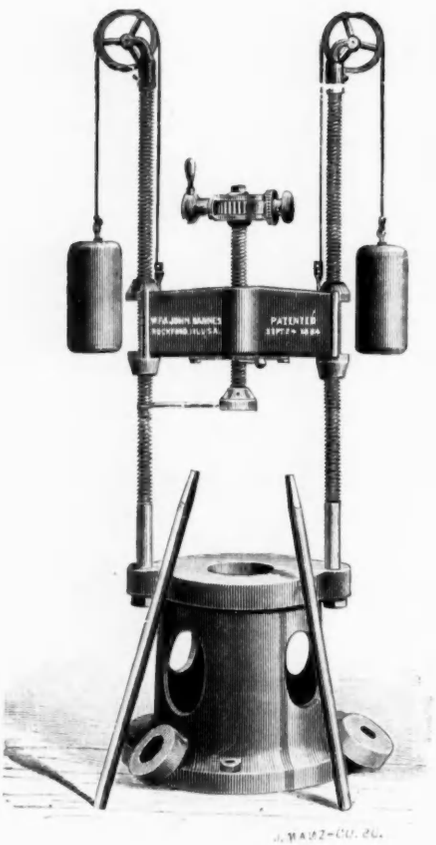

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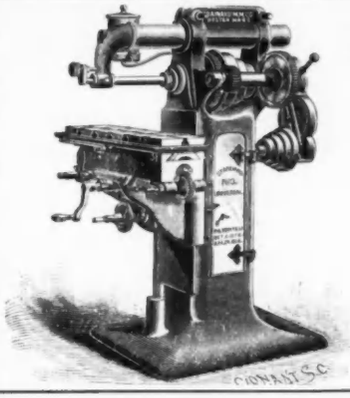

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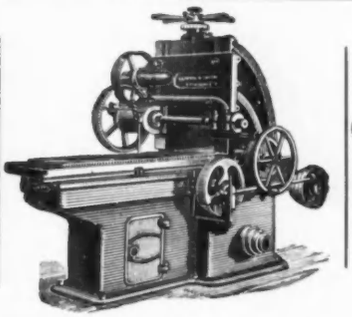

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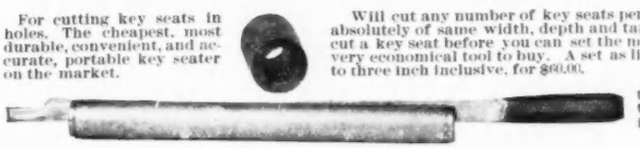

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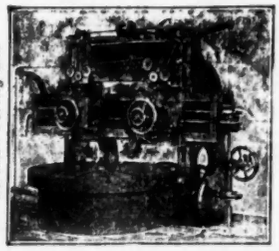

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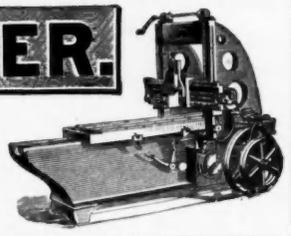

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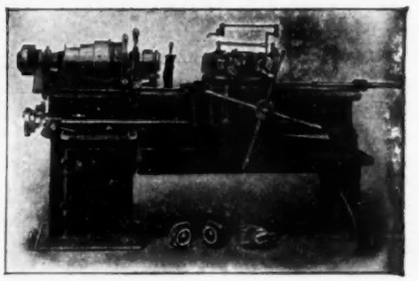

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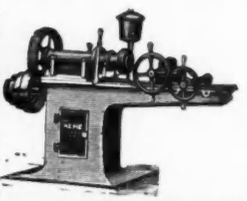

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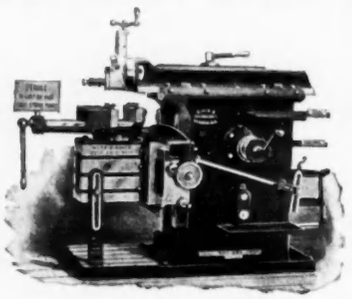

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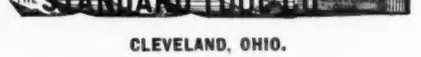

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